RAILROAD GAZETTE

LAKE BAIKAL WAR TRAFFIC.

The conduct of traffic across Lake Baikal last winter must count among the most remarkable of military operations. The ice-breaker ferry boats, something of the pattern of those which ply across the Straits of Mackinaw, have been able to cross the lake but a few weeks of each winter. The length of the ferry until a few months ago was 42 miles. On the average the two boats, one large and one small, have been able to make but three passages in 48 hours, with capacity altogether insufficient for the forwarding of men and supplies of a large army, and this year they made their last winter passage January 27. Meanwhile, by building on the east side of the lake, where the ground is not difficult, a section of the line around the south end of the lake, a harbor (Tanchoi) was reached, which is only about 25 miles from the terminus on the west side of the lake, and to this troops were marched over, and supplies carried in sleighs; while the light railroad laid on the ice, and worked by horses, was opened March 2, when 20 cars were hauled across; later on, some days as many as 220 cars crossed, and by March 14 no less than 1,300 cars had been transferred to the east side. But the railroad was not like one on dry land, or even that over the smooth surface of the Mississippi, on which Milwaukee & St. Paul trains used to cross. Great longitudinal cracks in the ice appeared from time to time, sometimes nearly 6 ft. wide, and the track would be shifted as these were closed. Where they were most frequent a grating of rails and timbers was placed under the track, which had to be watched constantly. When the cars had been mostly transferred and it was thought that the track had been got into pretty firm condition, it was ventured to haul locomotives over it. An old 30-ton engine sank with its fore wheels, but was raised again. The heavier engines (some 50 tons) were taken apart, the boiler, etc., loaded on two cars, and the frame and running gear hauled on its own wheels. In the course of four days 65 engines were transferred to the east coast. March 26 a wide fissure parallel with the track appeared, the weather moderated, and on the 27th the track was taken up, after 2,313 freight cars, 25 passenger cars and 65 locomotives had been hauled across, together with some 25,000 tons of freight; while 16,000 men had crossed on sleighs.

In April the navigation was open. The two regular ferry boats cannot transfer more than about 1,200 men per day; but the government has impresed nearly all the private steamboats on the lake, which are quite numerous, and with these it should be possible to transfer men and supplies faster than the railroad can bring them. Meanwhile, work is progressing with great energy on the unfinished part of the connecting line around the south end of the lake, over precipitous crystalline rocks, cleft in the most irregular manner by earthquakes. Notwithstanding the difficulties, it is expected to have the line in operation before the end of summer.

RESPECT FOR THE LAW.

The Century dictionary defines the expression *reductio ad absurdum* as the proof of a proposition in geometry obtained by proving the falsity of its contradictory opposite. This form of argument, often used by the old-time rhetorician as a graphic means of enlarging a fallacy in his opponent's argument, is a good test to apply to an economic problem, for the reason that the end, when logically carried through, is apt to look quite different from the beginning. Perhaps the recent anarchy in Colorado, bordering almost on civil war in its intensity, may not have been wholly bad, since it has served to demonstrate with wonderful clearness what is bound to happen when either side, or both sides, in such a controversy, disregard all laws and all principles except those of immediate expediency, and hold their cause as of greater importance than the very sinews of the state.

There is probably not much to choose between the methods employed respectively by the mine workers and by the mine owners in Colorado, although in the matter of provocation, which the law takes into account, the mine owners seem to stand on the firmer ground. With the quarrel under way, the picturesque but astonishing war cry, "To hell with the Constitution!" was the rule of action for both parties in the controversy. We say this with the fullest belief that under circumstances as they existed, some form of military government was necessary, and with the fullest understanding that the laws are silent in the presence of troops. But when the Governor first called out the guard to protect the mines, actual rioting had not commenced, and in spite of the fact that it required no special gift of prophecy to see breakers ahead, it is perfectly evident that, in the interest of the mine owners, he flagrantly exceeded his authority.

The lesson of the Colorado strike, where the attitude of the strikers toward the law varied from that of all mobs everywhere in this country only in degree, seems to be that as soon as the conflict becomes hot, the contestant strips off the encumbrances of law as an athlete throws aside his blanket before entering a race. The Colorado strike has answered the outcry of the labor leaders in Pennsylvania and Chicago against government by injunction, which is at least a legal form. At Cripple Creek the government is by strength, and the strength, however misapplied, is at present directed against riot. This, then, must be the final outcome of a conflict where both parties look on the law with undisguised contempt. It has been carried out to the uttermost dregs in Colorado, with the result that the state is governed by its troops, who are at the call of one man. It chances that the present incumbent upholds the mine owners; therefore the state is controlled by the mine owners. The next governor may favor the Western Federation of Miners, in which case the state will be controlled by the strikers. And meantime, the state laws and the national Constitution are laid aside, like the Greek poets, as documents interesting but not timely.

What further absurdity is needed to complete the proof that government without regard to the law is no government at all? If the present state of affairs is the logical outcome of every strike where there is picketing; of every riot, and of every cry against the use of the injunction, it is no less the logical outcome of similarly high-handed acts by great corporations that have rightly given grounds for the suspicion and distrust which surround them. Individual law-breakers like the poor, are always with us, and occasion no special alarm, but the great need, for employer and employee alike, is a far deeper respect for the law; an understanding, on the one hand, that corporate dishonesty is the same as personal dishonesty, and, on the other, that it is quite as culpable to kill a man because he wants to work as it is to kill a man for his pocket book. That is an extremely simple principle, yet it is the root of the whole matter, and the Colorado strike of 1904 will, it is to be hoped, stand as an extreme example of what happens when an entire community tacitly accepts the assumption that the right of a mob, whether of strikers or of non-strikers, to ignore the law, is superior to the right of the individual.

STREET RAILWAYS AND THE MUNICIPALITY.

There are three prominent grades of corporations which, in their relation to our municipalities, fall into the general class of "public service" corporations. They are (1) corporations that supply water; (2) corporations that supply light and (3) the street railways. To these should, perhaps, be added in the primary class the telephone and telegraph companies and, in a secondary class, steam heating supply corporations and corporations that operate vehicles other than street railroad cars. In the order of public necessity, saying nothing of convenience, the supply of water and light undoubtedly come first. The supply of municipal water dates far back to the ancients and, of light, at least to the time when Macaulay tells us that new street lamps were more effective than the whole corps of city watchmen in diminishing crime o'nights in London. And it is due to this antiquity of water supply and of street lighting, as well as to the magnitude of the service required—in times when corporations were limited in their resources and aims—that we find, so often as we do, those branches of public service under municipal ownership. If water supply companies had been active in the days of Cicero or lighting corporations in the seventeenth century, there might be now a different tale to tell. As it is the principle of inheritance applies to both those kinds of public service.

Not so with the street railway. Like the steam railroad its active history goes back but a few decades. Its beginnings were small. It required at first but a trifling capital. A corporation capitalized at a few thousand or, indeed, a few individuals, could supply the funds for a short horse railway of the old-fashioned type, perhaps operated for but a mile or two through a single city street. The single track represented no "servitude" on the through fare either in a technical and legal or in a practical sense. The "public service" idea was in the remote background; indeed, the phrase "public service corporation" did not until a comparatively recent date come into use. Naturally enough, therefore, as a localized concern in

the municipality the street railway began with a chartered corporation, and in this country the precedent has been followed as distinguished from a different policy in some foreign cities. And this notwithstanding the growth of the public service which the street railway supplies to a magnitude almost equal to that of water and light supply; notwithstanding greater servitude on streets by multiplied tracks and larger and more frequent cars; and notwithstanding the consolidation of many companies into one, the vast increase of receipts and profits and the greatly enhanced value of the street railway franchise.

It is perfectly natural that under these new conditions there should be movements in the direction of municipal ownership of street railways especially marked just now in some of the cities of the Middle West. And, since the application of electricity to the street railway, the movement as a more general fact has been somewhat strengthened by the double function of the street railway company of supplying light and power as well as transportation. As a lighting concern the street railway company has often invaded the province which a municipality has hitherto occupied, and in the future is likely to do so more and more. Hence a clashing of interests of which the tendency is to thrust municipal ownership to the front. Partly, perhaps for that reason but probably more from the broader theory of restricting the street railways to their "regular" business. The railroad commission of Massachusetts has been stoutly opposing a bill—which, however, has passed the State senate—which practically opens the field of electric lighting to the street railway corporations of that commonwealth. As further illustration of a tendency may be noted the merger of practically all its controlled trolley companies in Connecticut by the New York, New Haven & Hartford, under a "liberal" charter of one of the corporations which specifically grants the right to sell electric power and light.

But there are opposing forces and exceedingly powerful ones, both of an economic and a civic character, which resist the tendency to municipal control or ownership of the street railway. The danger of such an expansion of the sphere of municipal politics and spoils, as tested both by American experience and theory, is a trite argument but not for that reason less strong; and to be added to it is the fact that the rapid increase of street railways every year complicates the problem and makes the civic experiment more perilous. The city of say 100,000 inhabitants which 20 years ago might have taken over experimentally ten miles of horse railway with comparatively little risk to its tax rate or to its political morals faces a different proposition when the purchase of 100 miles of trolley track, with its equipment capitalized at several millions, is involved. Again, there may be cited a tendency especially in New England, to recognize and amplify the regulation power of the municipality over the street railway. It does not often extend to fares but it does reach such matters as layout, costs of paving and physical condition of roadbed and track. More important, in many States, is the element of local taxes in which the right of the municipality is apt to be expressly, and often liberally conceded. When a municipality can "regulate" with considerable freedom—and can acquire greater power by legislative grant—and when also it has big trolley tax receipts, its taxpayers are hardly apt to aspire to municipal ownership. Finally, in a more hypothetical and long look ahead, the drift toward acquisition of street railways by the steam companies seems certain to antedate ownership by cities. Such a consolidation may raise for future generations in new shape the question of federal control of the blended properties, but would, for the same reason, extinguish the municipal claim.

To summarize a situation, while the street railways have, from growth and other natural causes, come to assume a more close and intense relation of public service and in this way raised in certain cities the issue of municipal control much more potential obstacles have been created against it. Posterity may see the experiment tried in a few communities but never on an extensive scale—and with resulting failure, when tested, unless the economic conditions of American municipalities undergo a change radical, not to say impossible.

The Railroads of the World.

The annual statistics of the *Archiv fur Eisenbahnwesen*, giving as near as may be the figures for the end of the year 1902, show the mileage of railroad at that time in each grand division of the world to have been as follows:

Europe	183,997	North America.	233,186
Asia	44,358	South America.	28,822
Africa	14,554	Australia	16,038
Old World..	242,909	New World..	278,046

This makes a grand total of 520,955 miles for the whole world, of which 53⅓ per cent. is in the New World and 44¾ per cent. in North America.

The additions to the railroads of the world for seven successive years have been, in miles:

1896.	1897.	1898.	1899.	1900.	1901.	1902.
9,796	10,747	10,864	13,533	10,800	16,551	13,338

This gives a total of 85,629 miles for the seven years, being an average of 12,233 miles per year. The average mileage built was greatest from 1880 to 1890, when it was 15,218 per year.

The considerable decrease in construction from 1901 to 1902 was due chiefly to the reduced construction in Asia (4,345 miles in 1901 and 2,535 in 1902) and Africa (1,690 miles in 1901 and 364 in 1902). More was built in America in the latter year than for several years previous; and more than appears from the *Archiv's* statistics, which takes its figures for the fiscal year ending with June for both Canada and the United States, which together have more than two-fifths of the world's mileage, and where more than two-thirds of the railroad completed in any calendar year is opened in the last half of such year.

The countries of Europe which added most to their railroad mileage in 1902 were:

France.	Germany.	Russia.	Sweden	Austria Hungary.
619	615	581	366	340

All the rest of Europe built but 664 miles. Russia is credited with no addition to its mileage in Asia in 1902, but 629 miles were opened in India and Ceylon, 165 in Japan, 174 in China, 95 in Siam and 12 in Corea. The table also includes 1,490 miles in French Cochin China, the larger part of which certainly is not built yet.

The English-speaking peoples maintain their position as the railroad-building race. Of the 520,955 miles of railroad in the world, 270.881 miles are in the United States and in Great Britain and its colonies. The railroad mileage of the British colonies in America though not one-tenth as much as that of this country, is nearly twice as great as that of any other American country, and Great Britain still has more than three-fifths of the Asiatic railroads, and since 1898 has built a fourth more than Russia in Asia.

The South American countries (with which we have included the West Indies) make haste slowly. They added but 234 miles to their lines in 1902, and but 1,804 miles in the four years then ending. Brazil, that great country, is credited with no addition since 1899, and Argentina, the United States of the Southern continent, with none in 1902, and but 406 miles since 1899.

The *Archiv fur Eisenbahnwesen* continues its tables of the capital invested in the railroads of the different countries, which it began a few years ago. Naturally, they are less complete than the statements of mileage; but the mileage for which the figures are not attainable cannot be very important. According to these data, the investments in the railroads of the world amounted at the end of 1902 to the stately sum of $34,964,342,000, of which more than $18,800,000,000 have been spent on the 184,000 miles in Europe and $16,160,000,000 on the 337,000 miles in the rest of the world. This gives an average of $114,760 per mile for the European, and of $57,009 for the Barbarian railroads. The country with the highest capital cost per mile is, of course, Great Britain ($256,839); the nearest approach to it is Belgium ($150,239). The cheapest in Europe are the Finnish State railroads ($32,104); but the private railroads of Sweden are put down at $22,558 per mile. Elsewhere the colony of West Australia has spent but $27,597 per mile for its lines (light, narrow-gage railroads); Japan, $38,320 (also mostly narrow-gage).

The summing up of the acquisitions of the world, all made within the last eighty years, in these instruments of production, results in something like awe. The capital which they represent could not possibly have been obtained in any previous age, and it is safe to say that the improved means of transportation themselves have made possible its accumulation and vastly more. The imagination is lost in efforts to foresee what may be the result in the next eighty years of these and of the other appliances which have so greatly multiplied the productive powers of man.

The Pennsylvania Company.

The report of the Pennsylvania Lines West of Pittsburg for the year ending December 31, 1903, shows a decrease of $230,968 in net earnings, accompanying an increase of 4,967,890 in the aggregate number of tons moved. This decrease is due in large part to the unusually high charges in the maintenance and conducting transportation accounts, which increased operating expenses $3,808,255 and more than offset a gain of $3,577,286 in gross earnings. Owing to the increased tonnage, freight earnings showed a gain of $2,730,121. The number of passengers carried increased 1,847,380, leaving a gain of $457,165, gross, in the earnings of that department. The average ton-mile rate on all lines of the system was 6.7 mills, an increase of .2 mills over 1902.

The increases in the expenses of all the roads in the system for the year are due largely to the advance in the rate of wages made in November, 1902, to increased prices

of fuel and materials of all kinds and to the congestion in train movement resulting from overtaxed facilities. On account of these expenditures, there was an increase of $867,806 in the maintenance of equipment account and an increase of $2,713,666 in the conducting transportation account. The improvement work on the main line of the Pittsburg, Cincinnati, Chicago & St. Louis was finished during the year with the exception of the track elevation plan in Chicago, which still remains to be done.

In order to reimburse the Pennsylvania Railroad Company for sums advanced by it for betterments and for the purchase of additions to rolling stock, the Pennsylvania Company has issued its collateral notes to the amount of $50,000,000, bearing interest at 4½ per cent. per annum and running for a period of 18 months from April 1, 1904. The payment of these notes is guaranteed by the Pennsylvania Railroad Company.

After deducting $3,000,000 from net income for extraordinary expenses, $1,600,000 for 4 per cent. dividends and $1,583,137 for sinking-fund purposes, a balance of $276,590 was carried to the profit and loss account, making the latter $6,398,949, as compared with $6,122,360 in 1902. The summary of the year's operation follows:

	1903.	1902.	Increase.
Gross earnings..	$36,602,935	$33,025,648	$3,577,286
Freight earn'gs..	27,696,777	24,966,656	2,730,121
Pass. earnings..	6,117,930	5,660,764	457,165
Total operat. expenses	27,116,684	23,308,429	3,808,255
Maint. of Way..	4,341,853	4,371,003	*29,150
Maint. of equip..	6,066,670	5,198,863	867,806
Conduc. of transportation	14,836,711	12,123,044	2,713,666
Net earnings....	9,486,251	9,717,219	*230,968
Interest, rentals, etc.	8,734,076	7,890,440	843,637
Net income.....	5,119,641	5,783,985	*664,344
Extraordin'y appropriation ...	3,000,000	2,000,000	1,000,000
Surplus to profit and loss.....	6,398,949	6,122,360	276,590

*Decrease.

Local newspapers report that the locomotive enginemen of the Delaware, Lackawanna & Western have a serious grievance against their officers, and "it is rumored that the matter will be brought before the State Railroad Commissioners." It appears that, in order to test the faithfulness and accuracy with which the runners comply with the rules, false torpedo signals have been given, and, if the signal was disregarded, the engineman was "called down." The enginemen, says the reporter, dislike to be delayed; and "to have the stop simply to satisfy the officials that they are observing signals goes against the grain." In other words, the enginemen want to be their own bosses, instead of being bossed by the superintendent. Truly, a serious grievance! It is to be hoped that these enginemen are not so silly as they paint themselves when talking to the reporters. It would be a good thing if such a grievance were to be brought before the Railroad Commission (though it cannot be that the enginemen are so foolish as to think of taking such a means of promoting their claims) for then the Commissioners could, from their records, bring out the other side of the story: how collisions are occurring every month by reason of the lack of discipline among enginemen. The truly level-headed engineman would ask for more surprise-checking, rather than less. Only the other day the newspapers told of a collision (in New York State) in which an engineman, 65 years old, and with an excellent record, ran into the caboose ahead and was himself killed, the explanation being that he failed to properly reduce his speed on approaching the yard-limit post. In other affairs, where accurate care is essential, men have to be disciplined, or to discipline themselves, constantly, even to old age; but in locomotive running it seems to be deemed sufficient to trust to habit and to past success—which may be partly due to good luck. Those superintendents who are not satisfied to trust blindly to records have a duty to publish their principles; and that small minority of enginemen who believe it is wise to be strict with themselves as well as to be sharp in dealing with the company have a duty to support such superintendents.

Notwithstanding a large decrease in gross earnings, the recent report of the Pennsylvania Railroad Company for the month of May shows a tendency the right way in the effect on operating expenses of the retrenchment policy. Heavy decreases in gross were to be expected owing to general stagnation and the specific depression in the iron and steel industries, from which the Pennsylvania Railroad derives much traffic. The losses in gross for the month of May were $518,400 on the lines east of Pittsburg, and $539,100 on the lines west. Operating expenses, on the other hand, decreased $128,800 on the lines east, and $310,200 on the lines west. This shows that the conservative expenditure policy has in part, at least, tended to offset losses in earnings. As these losses have been due in large part to adverse weather conditions and to general industrial depression, they should prove merely temporary. As soon as a fair harvest is assured—and the prospects of a bumper crop seem good—the railroads will begin to pick up their traffic again and earnings should quickly improve. The numerous appropriations made by the Pennsylvania during the last two years for betterments have placed that company physically in such a position that even if earnings continue as bad as they are now, no new appropriations should be necessary for several years to come, and operating expenses can probably be so kept down as to offset adverse traffic conditions.

NEW PUBLICATIONS.

Report of Proceedings of the International Fire Prevention Congress, convened in London, July 6 to 11, 1903. Prepared at the request of Jacob A. Cantor, President of the Borough of Manhattan, by Ira H. Woolson, E. M., Adjunct Professor Mechanical Engineering, Columbia University, and Official Representative for the City of New York. Printed by Martin B. Brown Company, 49 Park Place, New York, 1904.

The city authorities, through the office of the borough president, have just issued this report of the New York delegate, Professor Ira. H. Woolson. The report at hand is the only one issued in this country, and contains a complete digest of the whole proceedings of the congress so far as construction and protection are concerned. As it is composed of papers presented at the congress by eminent authorities from all parts of the world, it is a valuable document on the subject of fire prevention, and should be useful to city architects, building bureaus and engineers having charge and care of large public and commercial buildings. The chairman of the congress, in his opening address, called attention to the fact that while fire brigade gatherings, etc., have frequently been organized to exchange experiences relative to fighting fire, the world had never before seen a fire prevention congress or a conference of all those who were interested in precautionary measures for the prevention of outbreak and spread of fire. There are chapters on municipal fire protection as influenced by street planning and building regulations in Germany; on building construction from a fire brigade officer's point of view; fire preventive sections of the London Buildings Act; the planning and arrangement of large retail commercial establishments; safety and control arrangements for fire alarms; fireproof wood as a building material; fire patrol service for dock property, etc.

Moody's Manual of Corporation Securities, 1904 edition. 2,464 pages. Price, cloth, $10, prepaid. The Moody Publication Company, 35 Nassau street, New York.

The 1904 edition of Moody's Manual is much larger than previous issues, and is in every way more complete. The field which this standard reference book of corporations covers is well known. It may be said briefly that it fully treats of the entire field of American corporation investments, describing each corporation fully with regard to statistics and property owned and controlled, capitalization and bonded debt, dividends paid, financial conditions and earnings, officers, managers and directors, addresses of plants, offices, etc. Particular effort has been made this year to elaborate those sections devoted to steam railroads and other public service corporations, and in the railroad bond descriptions a much wider scope is followed than has been the case heretofore. The corporations are clearly indexed in the front, and there are also special indexes, such as the one in which the classification is by cities, and the list of industrial and other companies which have been absorbed or are controlled by larger corporations. The book is divided into eight sections for purposes of convenience and of centralization, and is illustrated with a number of specially prepared maps. It represents an enormous and cumulative amount of work, each edition in the past having helped to further the completeness of this present one. It is a necessary part of a contemporaneous financial library of reference books.

TRADE CATALOGUES.

The American Brake Shoe and Foundry Company, Mahwah, N. J., has published a booklet describing its exhibit at St. Louis. This exhibit, which is designed to show the development of the brake shoe, is divided into two sections. The first section, which deals with unflanged shoes, illustrates the development of the wearing face of the brake shoe to secure durability and efficiency and the means employed to reinforce the shoe against failure by reason of the body metal cracking. The second section treats of flanged shoes and illustrates the development of the wearing face to prolong the life of the shoe and the means of reinforcing the body metal to continue the shoe in service in event of the body metal cracking.

The Consolidated Railway Electric Lighting & Equipment Company, Hanover Bank Building, New York, issues a pamphlet describing its axle light system of electric lights and fans for use on railroad trains. The principal parts of this system consist of a dynamo, storage battery and regulator, and the power is transmitted from the car axle by means of a rubber belt. The axle light system is now being exhibited in St. Louis on the Missouri Pacific train built by the American Car & Foundry Co.

The Midland Railway Supply Co., Chicago, has issued a catalogue of Perry roller side-

bearings for all classes of railroad equipment, interurban and street railroads, wrecking cranes, steam shovels, etc. The Perry bearing is made up of 10 rollers, mounted on a carriage, which is normally held in a central position on the bottom bearing plate by means of light spiral springs. The catalogue also contains 30 pages of drawings showing the application of these side-bearings in different styles and sizes to all classes of car bolsters. It is made in a number of standard styles, and also in special sizes and designs for special service.

The Joseph Dixon Crucible Company, Jersey City, N. J., has sent out three small catalogues describing graphite cup greases, Ticonderoga graphite grease and Dixon's dressing for traction belts. Each of these catalogues contains an interesting description of the various machines on which graphite grease may be used as a lubricant, and also in cases of leather belting, where it may serve as a preventive of slipping and as a leather preservative.

The New Jersey Tube Company, Newark, N. J., has published a catalogue containing a complete description of its spirally corrugated boiler tubes with reduced fire-box ends. It is claimed that the chief advantage of these tubes is the freedom they give from live sparks, owing to the fact that the hot gases are retained for a longer time in the tube because of the rotating motion which is induced by the spiral form.

The Damascus Brake-Beam Co., St. Louis, Mo., has prepared a new catalogue for distribution, showing the latest designs of Waycott, Damascus, "Loupurex," and Harriman brake-beams for freight and passenger cars and tenders. The catalogue also contains the results of tests made on Waycott brake-beams at Purdue University, which show that these beams far exceed the M. C. B. requirements for deflection.

The Brown Hoisting Machinery Company, Cleveland, Ohio, is sending out a number of colored cards illustrating the different cranes manufactured by the company. Each card has a photograph of some special variety of crane on the front, with a short description of the machine on the back. These cards can be obtained on application at the company's exhibit at St. Louis.

CONTRIBUTIONS

The Diamond Jubilee of the Midland Railway.

London, June 13, 1904.

To the Editor of The Railroad Gazette:

Perhaps you will allow me to point out a couple of printer's errors in your artic'e of June 3, upon this subject. In line 10 from bottom of page 415, "7 ft. quays" should read "7 ft. gage," and in line 5 from bottom of first column on page 416, "Of these, three were passenger engines," should read "Of these 77 were passenger engines."

W. B. PALEY.

A Persistent Fashion in Car Windows.

To the Editor of the Railroad Gazette:

"It would be a great convenience to the large army of commuters if the railroads running into New York had windows in their cars which could be opened. Unless a man has been in training for some months and accumulated muscles to rival Sandow he can tug and tug, and swear and swear, but he will not be able to budge these windows an inch. The only thing to do is to let them alone and perspire. It would be a popular thing if pocket derricks could be invented for commuters, by means of which they could force open the windows and get fresh air. As for women—well, they simply can do nothing at all, and unless they get the assistance of half a dozen strong men, with an occasional porter and brakeman, with a lifting capacity of about 10,000 lbs. to the sq. in., all they can do is to admire the scenery from behind the panes.

"Will this ever be remedied by the railroad companies?"

The foregoing is copied from the *New York Herald* in June, 1904. It sets forth substantially the same state of things that have been described in the *Railroad Gazette* repeatedly in the last 25 years and which have been made the subject of items in the newspapers probably every year for forty years—or more. From present indications the facts may call for similar notice for forty years to come. The car window painter appears to be always the same, whether the year be 1904 or 1894, or 1854, or—1954. I suggest that the *Herald* have the foregoing letter stereotyped. Why do you not more vigorously push your scheme for the modification of the severe laws which forbid a man to have burglars' tools in his possession, and thus open the way for each passenger to carry a jimmy? If a few dozen passengers would each carry and use one of these useful little bars and would take pains, in opening the windows, to mar the sash sufficiently to attract the attention of the Master Car Builder we should have a reform; for the M. C. B.'s expense account would be touched, after a while.

R. M. K.

The Damage Suit Industry in Texas.

To the Editor of the Railroad Gazette:

In your issue of June 10 you printed an article calling attention to the enormous growth of the damage suit industry in Texas, showing that about $2,000,000 was paid out in interest in a single year, a growth of about $1,800,000 in 12 years. No other industry in Texas compares with this, and how can it be otherwise when the state lends encouragement by offering a premium to the parties engaged in it? It is a law in Texas that an attorney can contract with an adventurer in advance, to bring suit against a railroad company. Such a contract gives an attorney 40 or 50 per cent. of any amount that he can secure from the railroad in the interest of his client. It is not necessary for his client to have a just claim. Causes are manufactured out of claims that would not be recognized by claim agents or railroad attorneys in any other state than Texas. I recall a case where a firm of attorneys conspired with a fakir to bring a suit against a certain railroad. The fakir was a brakeman, who let himself fall off a car. He immediately placed himself in the hands of these attorneys and their physicians. He was supported by them two or three years pending trial. During the trial the fakir, taking offense at being refused money for drinks by his attorneys, conspired with the claim agent of the railroad that was being sued, and agreed to take $700, and give the railroad company a release, in which he acknowledged that he was not injured and that he had been supported by these lawyers ever since his alleged accident. The trial went on just the same, notwithstanding this release was filed with the court, and a judgment rendered against the company for $1,600 and costs. The fakir had already secured $700 and absconded. His lawyers were allowed $600 by the court on the strength of their contract with the fakir, and the railroad company paid the bill.

Of course, this industry is going to grow as long as it is encouraged and protected by the state laws, administered by courts prejudiced against corporations, and it is growing rapidly. Railroad companies, whose legal affairs were attended to a few years ago by one attorney, are now compelled to employ attorneys in every county seat in the State through which the railroad passes, and they are always kept busy.

TEXAN.

For Quicker Work in the Claim Department.

To the Editor of The Railroad Gazette:

One question which was disposed of without adequate discussion at the recent meeting of the Freight Claim Association, at Savannah, Ga., can be so easily settled, if only claim agents will take an interest in its settlement, that I feel warranted in bringing it to the attention of your readers. Not having been present at the Savannah meeting, I do not know why it was postponed or laid on the table; but whether it is or is not settled in association, there is nothing to hinder any two roads, or all of the roads in any territory, from taking action on their own responsibility. At any rate, they can agitate the subject, and agitation will do good. I refer to the letter of Mr. Edgeworth, of the Indiana, Illinois & Iowa, who recommends that claims be sent to the next road in interest instead of invariably to the next connection.

Much good paper and ink, and many hours' time of clerks who might otherwise be better employed, are used up in reading tedious piles of letters and then simply referring them to some one else for the desired information. Mr. Edgeworth, in his letter to the committee, said: "Some time ago, upon investigation, I found that about twenty-five per cent. of claims received in this office each day, in which this road was intermediate, were of the nature described, and that we in turn simply referred them on for information or to note information or remarks. I took the subject up with immediate connections and arranged with most of them to refer such claims direct. I also instructed my clerks not to handle such claims, but to return them to the road received from, pointing out why the claim was one which could be handled direct. The result is that we are receiving very few such claims at the present time." Mr. Edgeworth is satisfied from his experience that there would be very little trouble or friction from the adoption of a rule to send claims direct.

I need not tell your readers that the question of curing this widespread evil of delays in settling claims is one of long standing. Conventions have wrest'ed with it, off and on, for years. The grievances of shippers and consignees are so numerous that, in spite of the fact that little good has been accomplished by the complainants which have been made in the past, the complaining is still kept up. You cannot convince business men that the intolerably slow process which prevails in claim departments throughout the railroad world is necessary or reasonable. Consequently, every discussion between a shipper or a shippers' organization and railroad officers leaves the impression that the railroad men are not up to their business; and oftentimes, if we knew the inner feeling of the shippers it would be necessary to use stronger language than this. To speak plainly, they sometimes think that we are blockheads. The fact that Mr. Edgeworth has made an actual experiment with his connections should silence

critics. If anyone has an argument to offer against this proposition, I should like to hear it; but action, it seems to me, would be much more profitable than criticism.

G. F. H.

Locomotives for the Central South African Railroads.

The accompanying illustrations (Figs. 1 and 2), show a new locomotive recently built by the Vulcan Foundry, Ltd., of Newton-le-Willows, Lancashire, England, for the central South African railroads. The central South African system now includes all the railroads in the Orange River Colony and the Transvaal, as also the Pretoria and Pietersburg line. The gradients, for the most part, are exceptionally severe, the rise from the Orange River to the central plateau being 1 in 80, while the corresponding descent into Vereeniging is 1 in 100. Toward Johannesburg the gradients average about 1 in 80, while on some stretches of line, notably the descent into the Crocodile River valley, they are as steep as 1 in 60. With a view to hauling heavier loads than previously, the orders have recently been placed for the new locomotives, which, for power, size and weight, are exceptional for the 3 ft. 6 in. gage. The truck wheels are 2 ft. 6 in. in diameter, and the "drivers" are 4 ft. 9 in. in diameter. The cylinders are 18 in. x 26 in. The boiler has a total heating surface of 1,481 sq. ft., with 131 sq. ft. in the fire-box. The grate area is 21.75 sq. ft. The tractive force (taking 90 per cent. of the boiler pressure, which is 200 lbs. per sq. in.), is 26,602 lbs. The frames are the bar type, and the fire-box rests on them, in order to secure a wide grate. The engine, in running order, weighs 135,175 lbs. The tender is the 8-wheel type. The tender holds 4,000 gal. of water and 10 tons of coal, and weighs 109,395 lbs.

In addition to the "Pacific" type engines, there is to be used a number of six-coupled double-end tank locomotives, several of which are also being built by the Vulcan Foundry Company, and one of which is illustrated in Figs. 3 and 4. The truck and driving wheels are 2 ft. 6 in. and 4 ft. 6 in. in diameter respectively. The cylinders are 18 in. x 26 in. The boiler is the same as that of the "Pacific" engines, above described. The tractive force is 28,080 lbs. The frames are the bar pattern, machined out of rolled steel slabs. The engine weighs 176,760 lbs. The two side tanks have a capacity of 1,800 gal. of water, and the bunker holds 3 tons of coal.

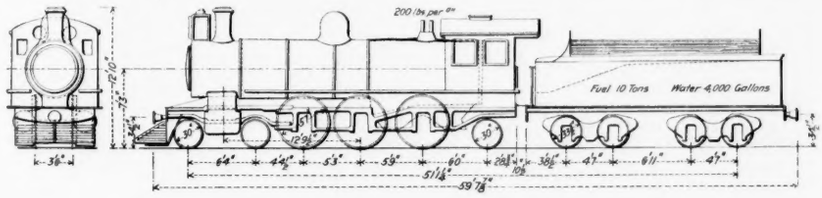


Fig. 2—Central South African "Pacific" Type Locomotive.

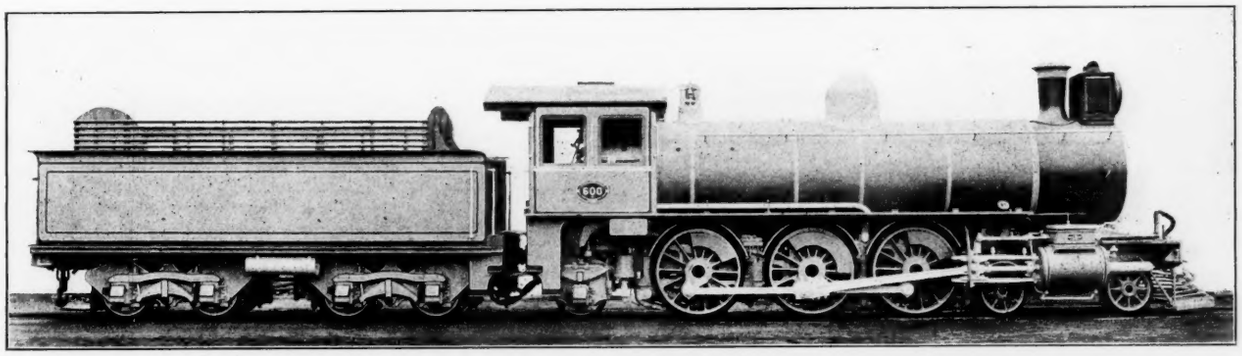


Fig. 1—"Pacific" Type Locomotive for the Central South African Railroads.

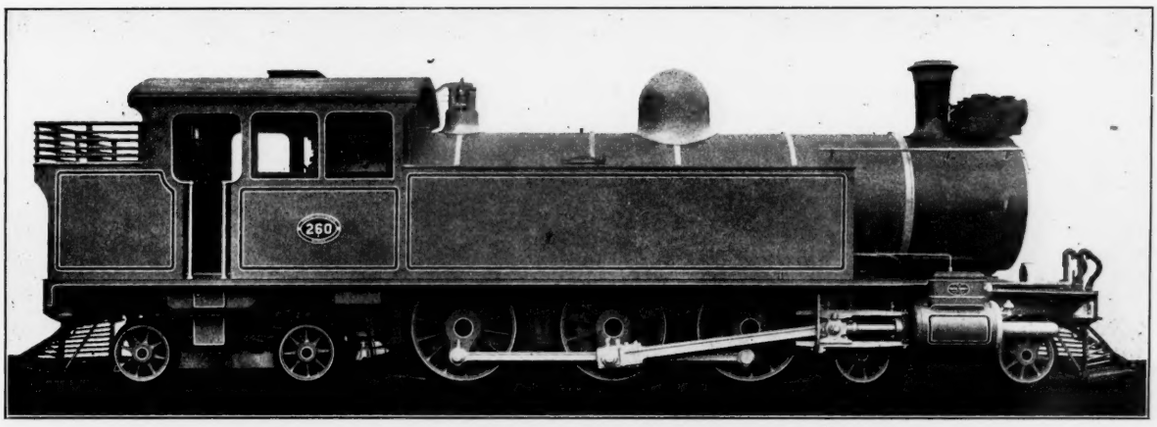


Fig. 3—Double-End Locomotive for the Central South African Railroads.

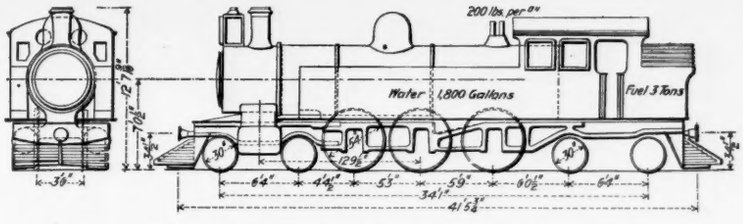


Fig. 4—Double-End Locomotive—Central South African Railroads.

The Roundhouse Foreman.*

Mr. Thompson's main points were that the roundhouse foreman should have authority equal to that of the master mechanic; should have clear judgment and know how to handle men; and he must be able to conclude quickly, after listening to the engineer's tale of woe, whether to accept it as a straight story or tell him that the engine must be made to run another trip without repairs. He must be a good all-around organizer and capable of promptly taking care of his business during rush hours. He must

*Abstract of paper by N. O. Thompson, read before the New York Railroad Club, May 20, with discussion by Messrs. McIntosh, Hayward, West and others.

be a man who can make brief and intelligent statements; he should be an engineer of known ability; he must have mechanical ability enough to decide what work can be slighted or not done at all and the engine be safe to make one or more trips; he must be broadminded enough to recognize that there is a commercial side to the transportation of freight and passengers on a railroad. The runner who has been earning $150 to $175 a month cannot be expected to do well as a foreman at $125 a month, working ten or twelve hours a day. Notice your foreman when things are going smoothly as well as when things go wrong. Do not reduce his force, but in dull times give him some engines to overhaul. Do not burden him with office work; it is more profitable to hire a $50 clerk. The successful shop foreman is not necessarily the best roundhouse foreman.

Mr. McIntosh—Most roundhouses are sadly deficient in modern conveniences. More repairing ought to be done in the roundhouse. With the varied new appliances now in use on engines, many more conveniences are needed in the roundhouse; the stitch in time that saves nine should be attended to in the roundhouse.

The ideal roundhouse foreman should have the following qualifications: He must not be either too old nor too young; must have a good education and a thorough knowledge of handling and repairing locomotives; must know how to handle men successfully; be diplomatic enough to keep on good terms with yardmaster, trainmasters, train despatchers and others; must be of a cheerful disposition—optimist preferred; will not object to being on duty 52 Sundays and 300 nights each year; is not affected by climatic changes and willing to transact business out of doors in the absence of shelter; he must not murmur when obliged to pull one engine apart to repair another while awaiting the convenience of the storekeeper and purchasing agent to bring up supplies; he should always have a few engines up his sleeve to meet emergencies.

Mr. Hayward—This position has been much changed during the past ten years. We can no longer depend upon finding good roundhouse foremen among superannuated runners; we must educate men by putting them through the shops, then in the roundhouse, then on the road and then back in the roundhouse. There is great economy in roundhouse repairs; $10 properly spent here will save $100 in the shop. Therefore, we must have well-equipped roundhouses, a foreman equal to a master mechanic, and he must have all the cardinal virtues.

Mr. West—The foreman must hear complaints cheerfully, and, if he cannot repair the engine, must give the runner the necessary encouragement to keep him agoing until the next day. Engines fail not alone by reason of mechanical conditions, but because the men on them are disgruntled.

Mr. McIntosh—Mr. Forney's mention of discovering a crack in a truck wheel carried me back to some early railroading, more years ago than I care to admit, where a party we will call Billy was operating a locomotive in the capacity of engineer and Mike was firing for him. Mike was ambitious and often looked the locomotive over to find out if anything was wrong with it. Just about Christmas one year Mike crawled down around the engine and came out, very officious, and said, "You have got a crack in your truck wheel," and the engine was taken out of service and Billy missed the run out; but he got Mike in a corner and said, "You blanked idiot! What did you go poking around that wheel for? I was saving that for Christmas for a lay-off."

Mr. West—For the past four months we have had at one division terminal a separate man to attend to the despatching, and it works very satisfactorily. He keeps in touch with the train dispatcher and the man who attends to repairs can devote his mind to his own work.

Mr. Hayward—We have lately put this into effect at Waldo avenue, Jersey City, and find it a great advantage. Much time is taken up in answering inquiries from the train despatchers and road foremen, and this change greatly relieves the roundhouse foreman. We have also put a competent man in charge of the ash pit; also, in repair work, we have organized gangs of men under a leader, thus arousing competition between rival gangs to get their engines out quickly.

Mr. Gaines—When a large number of engines come in about the same time, a good man at the ash pit can save time if, in conjunction with the runners, he will take out the engines in the lot that are ready to make another trip, and get these out ahead.

Mr. Maxfield—At Jersey City last winter roundhouse foremen had very severe experiences. With the thermometer 16 below zero, engines were frozen solid to the track and could not move with their own steam (the engines are so large that the roundhouse doors cannot be shut). . . . The whole secret of roundhouse work is efficient organization and an ample number of men. In winter it will pay to have twice as many men as in summer. During that cold weather from 15 to 20 per cent. of the men were absent, sick.

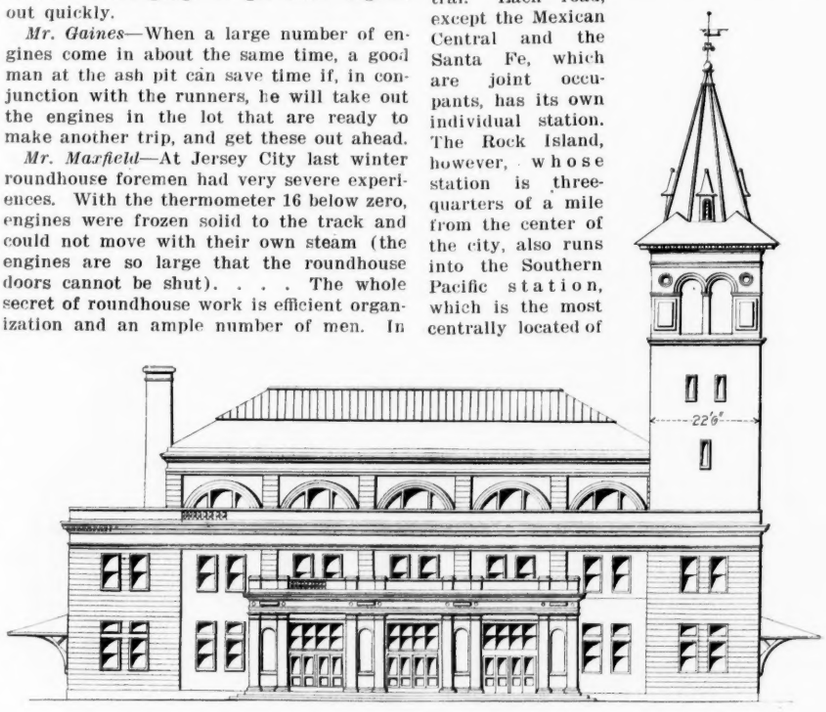
Mr. Bourne—I lately heard an attractive scheme outlined for covering the center of the roundhouse. It has been figured that it could be done for $500 per pit. Then the house could be warmed in winter and the men could get across from one side to the other much quicker.

Mr. Frost—At Jersey City we have a man who looks after stay-bolts alone; a boiler maker should have nothing to do with renewing stay-bolts. The man who hunts for defective stay-bolts should not have the work of renewing them.

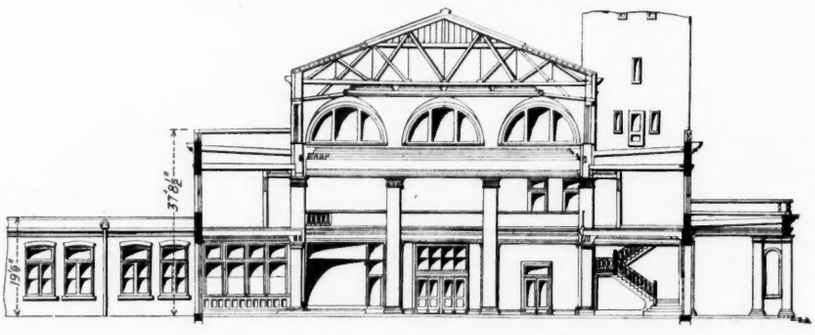
President Vreeland, in closing the discussion, told of the troubles of the electric railroad "roundhouse foreman," the man who has to see to the running repairs of electric street cars.

The El Paso Union Station.

El Paso, Texas, with a population of about 20,000, is the most important gateway between the United States and Mexico. Five lines of railroad enter the city, viz., the Southern Pacific, Texas & Pacific, Santa Fe, El Paso & Northeastern (Rock Island), El Paso & Southwestern and the Mexican Central. Each road, except the Mexican Central and the Santa Fe, which are joint occupants, has its own individual station. The Rock Island, however, whose station is three-quarters of a mile from the center of the city, also runs into the Southern Pacific station, which is the most centrally located of all of the stations. Plans have recently been completed for a union station, which will be located at the corner of Crosby and San Francisco streets, in the western part of the city. The site is about three-quarters of a mile from the business center and is near the river. When completed this station will be one of the finest in the Southwest.



East Elevation, El Paso Station.



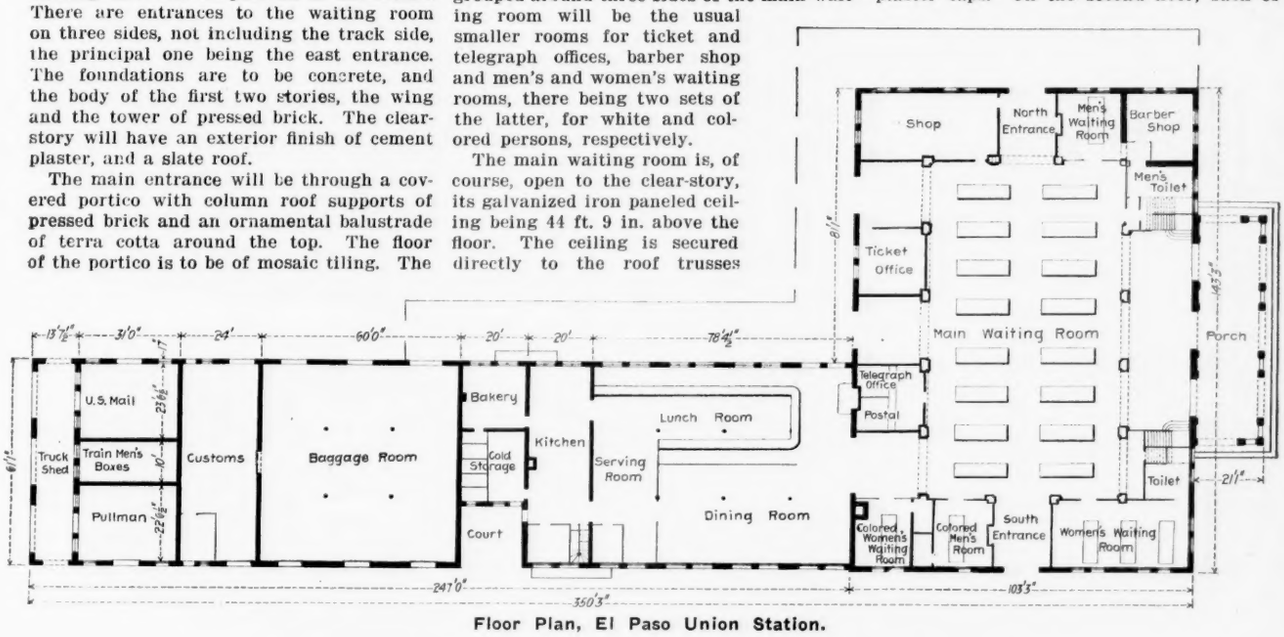
Cross Section Through Waiting Room.

Engravings from the architects' drawings are presented herewith, from which it will be seen that the main building is a two-story structure with a clear-story, and a

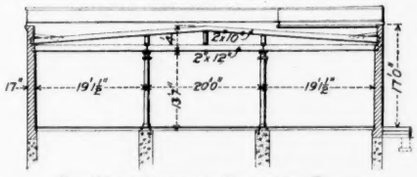
tower, 130 ft. high, at the street intersection. It is 143 ft. 3 in. x 103 ft. 3 in. and has a one-story wing 61 ft. 1 in. wide extending back 247 ft. parallel to the tracks. There are entrances to the waiting room on three sides, not including the track side, the principal one being the east entrance. The foundations are to be concrete, and the body of the first two stories, the wing and the tower of pressed brick. The clear-story will have an exterior finish of cement plaster, and a slate roof.

The main entrance will be through a covered portico with column roof supports of pressed brick and an ornamental balustrade of terra cotta around the top. The floor of the portico is to be of mosaic tiling. The main waiting room will be approximately 60 ft. x 100 ft. Two stairways leading to the second floor flank the main entrance, and grouped around three sides of the main waiting room will be the usual smaller rooms for ticket and telegraph offices, barber shop and men's and women's waiting rooms, there being two sets of the latter, for white and colored persons, respectively.

The main waiting room is, of course, open to the clear-story, its galvanized iron paneled ceiling being 44 ft. 9 in. above the floor. The ceiling is secured directly to the roof trusses and contains ground glass ceiling lights for transmitting the light from the galvanized iron skylights, with ribbed glass, in the roof. The clear-story has semi-circular windows in the side and end walls—five on each side and three on each end. Below these windows is an ornamental expanded metal and plaster cornice resting on columns of similar material, which are 3 ft. in diameter, 28 ft. high, spaced 20 ft. apart on centers and surmounted by ornamental plaster caps. On the second floor, back of these columns, is a balcony, with an ornamental iron railing between the columns. The second-floor offices open onto this balcony. The main waiting room will have a mosaic tile floor and plaster walls and ceiling. The first floor offices and waiting rooms will be similarly finished. The second floor balcony will have a wood floor, ornamental base and trimmings, iron balustrade with wood hand rail, plaster walls and the ornamental plaster cornice above.



Floor Plan, El Paso Union Station.

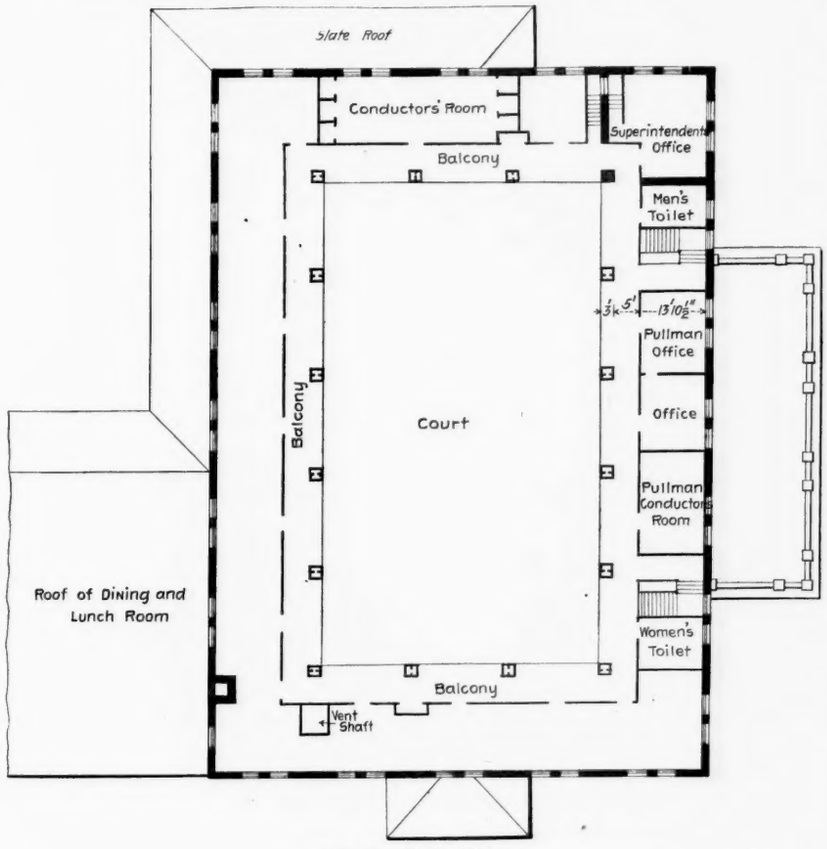


Section Through Baggage Room.

The wing will contain the dining and lunch room and kitchen, baggage room and several smaller compartments for customs, mail, trainmen's boxes, Pullman quarters, and at the west end a shed for baggage trucks. The dining and lunch room will be finished similar to the waiting rooms and offices. The remaining rooms will have cement floors, brick walls and plastered ceilings and will have rolling steel doors.

Starting from the east side of the north entrance, a stationary awning having a slate roof and supported on brackets secured to the building walls, extends around the track side of the station to just beyond the entrance to the checking counter in the baggage room. The usual iron fence will separate station and trucks, and cement walks will be laid on all sides of the building. All entrances will have stone steps. The building will be heated by steam and lighted by electricity, the light fixtures being combination electric and gas. At the outset the station will have eight tracks, six of which will be stub and the other two through. There will be no sheds, it being considered unnecessary to provide such protection in this dry, mild climate. The station complete will cost about $280,000; the amount for the building alone, however, will be something less than half of this. It is expected to have it completed the first of next year.

The Board of Directors of the union depot company consists of Messrs. H. U. Mudge of the Atchison, Topeka & Santa Fe, who is President; H. R. Nickerson of the Mexican Central; H. J. Simmons of the El Paso & Southwestern; C. B. Eddy of the El Paso & Northeastern; A. S. Johnson of the South-



Second Floor Plan.

ern Pacific; J. W. Everman of the Texas & Pacific, and W. W. Turney, representing the citizens of El Paso. The architects are D. H. Burnham & Company, Chicago.

Steel Car Design.

BY A. STUCKI.

III.

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Distortion of Trucks on Curves.—When rounding curves the inside wheels of a truck tend to run ahead and pull the truck out of square, owing to the difference in length of the two rails. (See Fig. 10.) The magnitude of the force f, tending to cause this distortion, is the weight on the two wheels

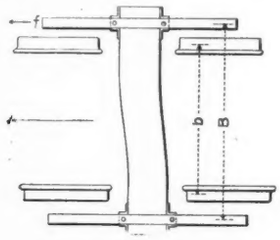


Fig. 10.

on one side of the truck multiplied by the coefficient of friction between wheels and rail. It is a minimum at high speeds and a maximum at low speeds when the load may be as high as $\frac{Q}{2}$. The stress in the arch bars due to this force is, $f = \frac{Q}{2} \times \frac{c \times b}{B}$ where c is the coefficient of friction and b and B are the dimensions shown in Fig. 10. Q is the load on the center plate.

The moment to be resisted by the connection between the arch bars and the transoms is $M = f \times \frac{B}{2}$, taking moments about the center pin. Since $f = \frac{Q}{2} \times \frac{c \times b}{B}$ then $M = \frac{Q}{2} \times \frac{c \times b}{B} \times \frac{B}{2}$ or $M = \frac{Q \times c \times b}{4}$

Assuming c as 0.3, the moments M, for the three capacity trucks are as follows:

M = 184,800 inch pounds for 60,000-lb. trucks.

M = 237,300 inch pounds for 80,000-lb. trucks.

M = 289,800 inch pounds for 100,000-lb. trucks.

If the connection is strong enough, the wheels will slip; but if the connection yields or is purposely given some play, the inside wheels will run ahead, causing the outside wheels to creep up on the conical tread and run on the portion with a slightly larger circumference. The inside wheels will work out until they run on the small circumference of the tread and the difference in the respective lengths of the path of travel for the two wheels is thus equalized so that the wheels will run without slipping.

Example: The maximum unit shearing stress in the column bolts of a 100,000-lb. truck due to distortion of the truck on a curve, with 1¾-in. bolts spaced 15 in. apart is found as follows:

$$\text{Shear} = \frac{\text{Moment}}{\text{Area of Bolt} \times \text{Dis. bet. Bolts}} = \frac{289,800}{2.4 \times 15} = 8,050 \text{ lbs. per sq. in.}$$

Lateral Motion Trucks.—Box and other cars having a center of gravity, when loaded, about 6 ft. above the rail and when mounted on the usual form of rigid bolster truck have a certain amount of lateral motion at the height of the center of gravity. It is made up approximately as follows:

	Resulting lateral motion.
5/16 in. Clearance between rail and flange.	5/16 in.
⅛ in. Clearance between body and truck center-plates	⅛ in.
3/16 in. Clearance between axle and bearing, each way.	3/16 in.
⅜ in. Clearance between body and truck side bearings	⅜ in.
½ in. Additional compression of springs.	1¾ in.
Total	3 in.

The effect of this lateral motion is to allow the car to run a certain distance beyond the point of tangency after striking a curve before all of the slack and lost motion is taken up and the pressure of the wheel flanges against the rails forces the center of gravity of the car out of its original straight path. This distance is:

85 in. on a curve of 100 ft. radius.
120 in. on a curve of 200 ft. radius.
147 in. on a curve of 300 ft. radius.
170 in. on a curve of 400 ft. radius.

Several forms of swing bolster and lateral motion devices have been applied to trucks, all of which accomplish the same end. Usually about 1⅛ in. additional lateral motion is given to the bolster in each direction. This permits the car to run a somewhat longer distance after striking a curve before the center of gravity is displaced, namely:

99 in. on a curve of 100 ft. radius.
140 in. on a curve of 200 ft. radius.
172 in. on a curve of 300 ft. radius.
199 in. on a curve of 400 ft. radius.

After the wheel flanges once touch the rails, the lateral motion and rigid trucks act alike and the flange wear on curves is the same for both. On a straight track, lateral motion trucks allow the cars to rock and sway more than with rigid trucks, causing them to ride somewhat easier. They also relieve in a small degree the binding of cars equipped with M. C. B. couplers when rounding sharp curves.

Helical Springs.—The following notation has been used: (See Fig. 11.)

	Large Coil.	Small Coil.
Diameter of wire	D	d
Radius of coil	R	r
Solid height	H	h
Load carried by one coil	P	p
Fiber stress per square inch	S	s
Modulus of torsion, usually taken as 12,600,000	g	g
Length of wire	L	l
Deflection of coil under load	F	f

The load per coil is $P = \frac{S \times \pi \times D^3}{16\,R}$.

The maximum fiber stress is usually taken as 80,000 lbs. per sq. in. and this value substituted in the above equation will give the maximum load to which the spring should be subjected. This is called the *capacity*. To prevent overloading, the spring should be designed so that it becomes solid when the load equals the capacity. Bars over 1⅝ in. in diameter are seldom used for spiral

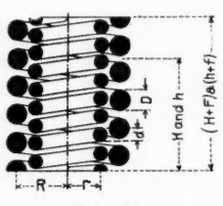


Fig. 11.

springs because of the difficulty of obtaining a uniform temper in the steel. The minimum radius of the coil should not be less than 1¾ × diameter of the wire. In order that the two coils of a double-coil spring shall work together in unison under a given load the proportion R : r = D : d should be strictly adhered to and the lengths of the two coils, L and l, should be made equal. For car springs, the working load is usually taken at 50 per cent. of the capacity.

The deflection of the coil under a given load is proportionl to the length of wire in the coil, all other conditions being equal. It is $F = \frac{2\,\pi\,RH}{D} \times \frac{32}{\pi} \times \frac{PR^2}{g\,D^4}$ or simplified, $F = \frac{64PR^3H}{gD^5}$. If the deflection F, corresponding to the capacity, plus the solid height H, equals the free height of the spring, the coil cannot be subjected to a fiber stress greater than the safe maximum of 80,000 lbs. per sq. in.

The length of the bar is $L = \frac{\pi\,RH}{D}$ and this length is used in calculating the weight of the spring, assuming .2833 lbs. per cu. in. as the weight of the steel. In practice, the bar is usually tapered at the ends without changing its mass so that

$$L_t = \pi\,RH\left(\frac{2}{D} + 1\right).$$

The minimum weight usually allowed is 97 per cent. of the normal weight.

Brakes.—The braking pressure exerted against the wheels of a freight car equipped with air brakes is usually adjusted to be equal to 80 per cent. of the light weight of the car, trucks included. The braking pressure exerted by hand brakes is usually taken at 90 per cent. of the light weight of the car and the system of levers is so designed that this may be obtained with a pull of 1,500 lbs. on the hand-brake chain. If the chain is wrapped around a 1¾-in. brake-shaft, an 18-in. hand wheel is sufficiently large to enable a man to exert this force. In applying the hand-brake rod to the cylinder lever, the connection should be in line with the cylinder push rod.

The cylinder pressure in the air brake system is normally a maximum at 60 lbs. per sq. in., which will exert against the piston a force of approximately:

1,700 lbs. in a 6-in. cylinder.
3,000 lbs. in an 8-in. cylinder.
4,700 lbs. in a 10-in. cylinder.
6,800 lbs. in a 12-in. cylinder.

Cars weighing over 40,000 lbs. should be equipped with a 10-in. cylinder so as to reduce the piston travel for a given movement of the shoes.

Curves over which a Car Should Pass.—All freight cars should be designed to pass around a curve of 150 ft. radius unless other special conditions are imposed. Although main line tracks seldom have curves of less than 300 ft. radius, shop tracks, spurs and sidings are often laid out with curves of as small a radius as 100 ft. The following table gives the radius of curves from 10 deg. to 40 deg. measured on a 100-ft. chord:

Deg.	Rad.	Deg.	Rad.	Deg.	Rad.
10	559.7	20	287.9	30	193.2
11	521.7	21	274.4	31	187.1
12	478.3	22	262.0	32	181.4
13	441.7	23	250.8	33	176.0
14	410.3	24	240.5	34	171.0
15	383.1	25	231.0	35	166.3
16	359.3	26	222.3	36	161.8
17	338.3	27	214.2	37	157.6
18	319.6	28	206.7	38	153.6
19	302.9	29	199.7	39	149.8

The Wheel Base of a Car.—On a curve, the lateral projection of a car is reduced to a minimum by making the distance between truck centers, c, Fig. 12, according to the table given below, the projection f, being

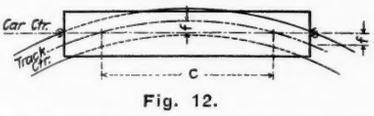


Fig. 12.

the same at the ends and center of the car. The table covers different curves and different lengths of cars. For different radii of

curves, the projection f changes, but the value of c does not. The column showing the value of c, gives exact and approximate values; the latter should be used in designing:

Length over end sills in ft.	C. to C. of Trucks. Ft.		Projection f, Fig. 12, in Feet on						
	Approx.	Exact.	75-ft. Curve.	100-ft. Curve.	125-ft. Curve.	150-ft. Curve.	200-ft. Curve.	300-ft. Curve.	500-ft. Curve.
30	20.0	21.10	.749	.56	.449	.374	.281	.187	.112
32	22.0	22.62	.835	.64	.512	.426	.32	.213	.128
34	24.0	24.00	.963	.72	.577	.482	.375	.241	.144
36	26.0	25.46	1.080	.81	.628	.540	.425	.270	.162
38	28.0	26.80	1.203	.90	.722	.602	.451	.301	.180
40	28.0	28.28	1.333	1.00	.800	.666	.50	.333	.200
42	30.0	29.70	1.469	1.10	.881	.734	.55	.367	.220
44	32.0	31.10	1.61	1.21	.968	.806	.60	.403	.242
46	34.0	32.53	1.057	1.32	...	.882	.66	.441	.264
48	36.0	33.94	1.15	1.44	1.15	.960	.72	.480	.288
50	38.0	35.35	1.25	1.56	1.25	1.04	.78	.520	.312

The Body Bolster.—The load on the body bolster may be concentrated at the center if all the load is carried by the center sills, it may be distributed nearly uniformly over the entire length of the bolster or it may be concentrated at the ends if the entire load is carried by the side sills or side framing. The bending moment at the center is a minimum in the first case and a maximum in the last case. It is well to design the bolster for the maximum bending moment so that failures may not occur when the car is jacked up under the ends of the bolsters and the entire load concentrated at those points. The center plate tends to distribute the reaction at the center over a short distance on each side so that the section required 4 in. from the center can be safely used at the center and the bolster made of uniform depth for at least 8 in. of its length at that point.

The maximum stress in the bolster exists when the car is on a straight track. On a curve, with the side bearings touching, the bolster is given additional support and will stand a much greater load.

On wooden cars with separate steel bolsters, the load in the car is nearly uniformly distributed and three-fourths of the weight of the car body is carried at the ends of the bolsters. The following may be considered as fair average values of the moments, 4 in. from the center, for the three capacity cars built in this way:

897,000 in. lbs. for 100,000-lb. cars.
715,000 in. lbs. for 80,000-lb. cars.
546,000 in. lbs. for 60,000-lb. cars.

It is not necessary to increase the section obtained by these moment values, if the car is to be jacked up at the ends of the bolsters.

For cars in which all of the load is carried by the sides and for cars having the load resting near the center, which are likely to be jacked up at the ends of the bolsters, the following may be considered as fair average values of the moments, 4 in. from the center:

1,670,000 in. lbs. for 100,000-lb. cars.
1,370,000 in. lbs. for 80,000-lb. cars.
957,000 in lbs. for 60,000-lb. cars.

These average values should only be used in preliminary calculations. The actual moments should be carefully figured after the form of construction has been decided upon and the location of the point of application of dead and live loads accurately determined. The stress usually allowed for body bolsters is 12,500 lbs. per sq. in for open hearth steel, carbon from 0.15 to 0.2.

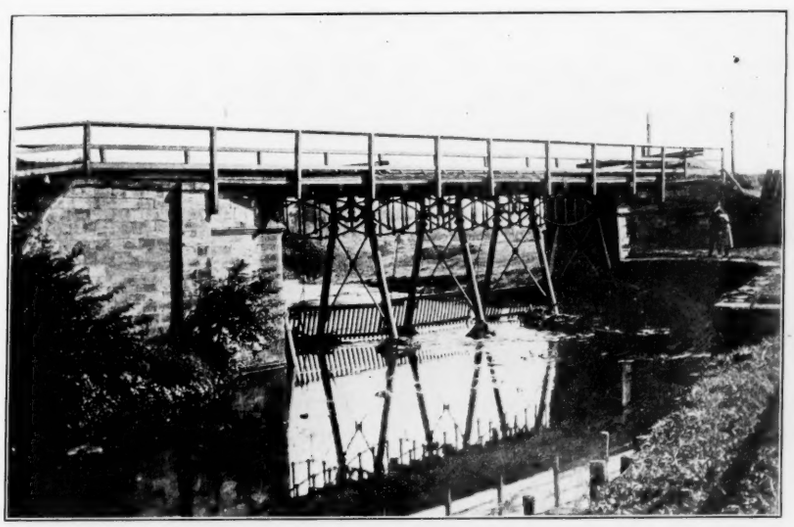
The rivet holes should be subtracted from the effective cross-sectional area in the tension members only. In the compression members, the rivets can be considered as filling up the holes. The king pin hole is compensated for if eight or more rivets are used in fastening on the center plate, and in such a case it should not be considered in estimating the cross-sectional area. The end sill and the diagonal braces will usually give ample support to the body bolster to resist horizontal stresses. If the diagonal braces are omitted, the bolster should be given ample stiffness in this direction to resist excessive end shocks.

(To be continued.)

The First Iron Railroad Bridge.

BY F. C. COLEMAN.

In the issue of June 17 was described and illustrated the first iron truss railroad bridge built in the United States—the Manayunk bridge on what is now the Catawissa branch of the Philadelphia & Reading, built in 1845. The accompanying photographs illustrate what is believed to be the first iron railroad bridge ever built, which was some time ago removed from the position it had occupied for nearly 80 years, constituting an interesting link with the day of the early railroad systems in Great Britain.



The First Iron Railroad Bridge.

This bridge was built in 1823 for the Stockton & Darlington Railway, the first public railroad system, and placed at the western extremity of the original main line, at a place named West Auckland, some eight miles northwest of Darlington. The bridge spanned the Gaundless, a tributary of the River Wear, and was in use when the line was opened in September, 1825, between Witton Park and Stockton. The bridge was composed of cast and wrought iron in combination, and is said to have been not only the first metal railroad bridge ever erected, but the only one of its kind. The piers were cast iron columns braced together, the bracing bars being connected at their point of intersection. The spans measured 12 ft. 8 in. The frames constituting the girder each consisted of a pair of wrought iron arched members united by cast iron verticals cast round them. Each frame had thus to act as a couple of arches—one arch being inverted, since there was no bracing between the verticals. All the shearing forces were therefore resisted by the curved members. The cast iron vertical pillars extended upward to form a support for the roadway. The ends of the top and bottom members had bosses cast round them and spigots were made to fit into the top of the column forming the piers. Each pair of columns was connected by a casting which fitted into the grooves in the bosses at the ends of the main girders; in fact, the entire general design was such that the structure should fit together like a puzzle. The bridge is believed to have been built to the designs of George Stephenson, who was at this time engaged as the Engineer-in-Chief of the Stockton & Darlington, although a Mr. Storey is generally credited with its erection.

Civil engineering at this period was scarcely recognized as a distinct profession. From the early correspondence of the Stockton & Darlington it is gleaned that the first bridge at Darlington, built for the company, was the work of an architect, Benomi of Durham, while the first railroad skew bridge ever built, spanning the River Tees at Croft Spa, was the work of a millwright. It was close to the spot occupied by the old bridge, shown in the illustration, that on the day of the opening of the "first public railroad" the proprietors assembled and were drawn up the Brusselton Incline, a distance of 1,960 yards, in 7½ minutes, which was not a bad performance for those early days of the locomotive. It was, however, with the view of obviating the disadvantages attendant upon this difficult climb that the construction of the Shildon Tunnel was undertaken in 1839, the work being completed in 1842, from which time the bridge was chiefly used for mineral and goods traffic. In consequence, however, of the increasing weight of the locomotives and train loads during quite recent years, it was deemed advisable to replace the old relic by a more massive and substantial structure, which is composed of plate girders placed directly under the rails. By way of comparison, it is of interest to note that "Stephenson's No. 1 Engine," to carry which this bridge was erected, had a total weight when in working

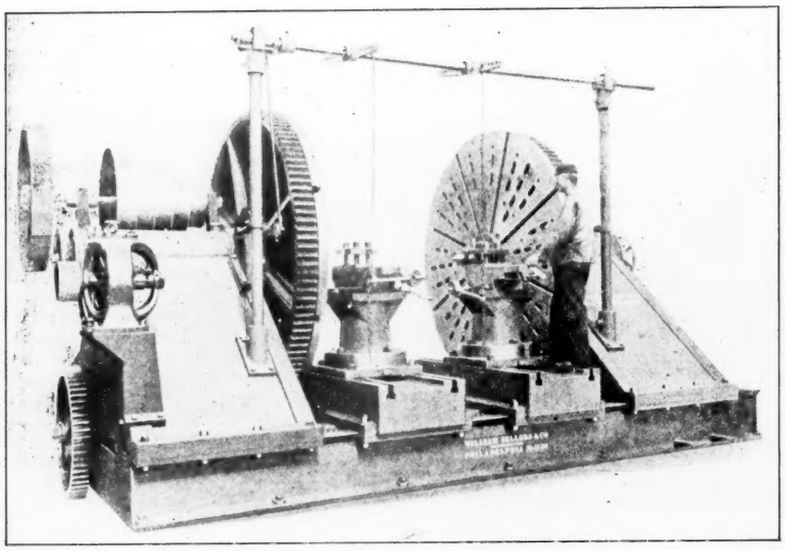


Fig. 1—The Sellers 100-in. Wheel Lathe.

order of 6½ tons and a nominal horse-power of 16.

It may be of interest to here make reference to the first railroad suspension bridge ever erected. By an Act of Parliament dated May 23, 1828, sanction was obtained to a Bill authorizing the building of a line between Stockton and Middlesbrough, including the building of a bridge across the Tees at the former town. The building of this, the first railroad suspension bridge, was intrusted to a Captain Brown, R. N. Before, however, bringing the bridge into traffic, the proprietors wisely decided to have it exhaustively examined. In the first experiment a weight of 18 tons was placed on the center of the bridge, which showed a deflection of 9.3 in. Further experiments were made, when 28 empty wagons were placed on the bridge with engine and tender, weighing altogether 37 tons and extending from one end of the bridge to the other. The result was a deflection of 2.3 in. Subsequent trials were carried out, with equally unsatisfactory results, and the engineers reported that trade might be carried on with the bridge as it was by passing loaded wagons over, one by one, the engine passing over first. It was added that the engine might return with the whole train of empty wagons connected closely together and that twenty wagons might be passed over this way in about six minutes, after the man got into the method. This mode of procedure was, for a time adopted, but it is not surprising to learn that before long a more solid structure had to be erected.

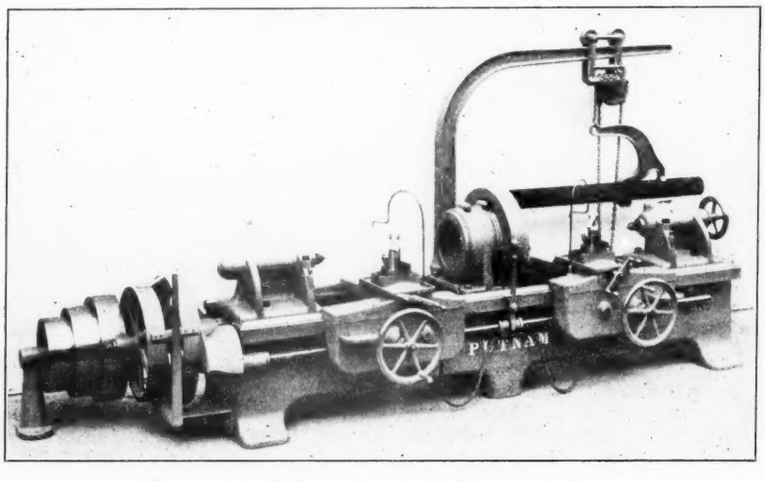


Fig. 2—The Putnam No. 3 Double-Axle Lathe.

Railroad Shop Tools

(*Continued.*)

WHEEL LATHES.

The 100-in. wheel lathe shown in Fig. 1 is made by William Sellers & Company. This lathe is arranged so that the bearings of the axles can be turned up by shifting the saddles on the bed, without taking the axles off the lathe. The saddles are made narrow enough so that in most cases they can be moved under the wheel flanges. The centers are set close to the back edge of the bed, so that the pressure on the tool falls within the bed surface. The feed is obtained from a rock shaft placed overhead and supported on columns, as shown. All the gears are cut from the solid. The two compound rests are operated by an electric motor attached to the machine. This lathe can be arranged for driving by electric motor. When operated by a countershaft the fast and loose pulleys are 36 in. in diameter x 7½ in. face, and should be run at 120 r.p.m.

AXLE LATHES.

The Putnam No. 3 double axle lathe shown in Fig. 2 will swing 22 in. over bed and 14¼ in. over carriage, and will take 8½ ft. between centers. The bed is 12½ ft. long. The carriages are independent and have three positive feeds for roughing and finishing. The driving head has six changes of speed, ranging from 10 to 40 r. p. m., and is

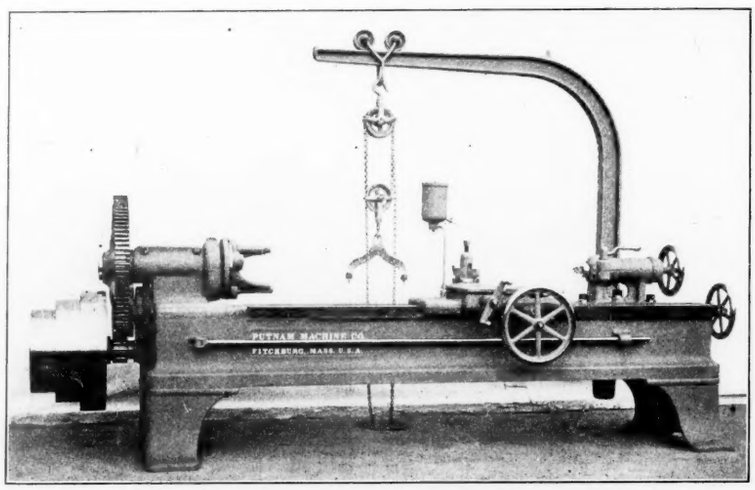


Fig. 3—The Putnam Single-Axle Lathe.

equipped with a quick-change device which enables the speed changes to be made while the machine is in motion. The driving head has a 13-in. opening and is operated by a 30:1 spur gearing, which is driven by a 26-in. cone having three changes for a 6-in. belt. The head has an equalizing self-centering dog ring, which prevents bending strains in the axle. The bearing has a compressed babbitt lining and an adjustable take-up. The main driving shaft is 3½ in. in diameter. The carriages have quick hand movement and are fitted with automatic safety stops which make it impossible for the carriages to collide or run against the driving head. The feed mechanisms have phosphor bronze pinions and the feeds obtainable are ⅛ in., 3/16 in. and ¼ in. per revolution of the axle. The tail-stocks are secured to the bed by four anchor bolts and are longitudinally adjustable on the bed. The right-hand tailstock spindle is operated by a screw and hand wheel and has a split collar. The weight

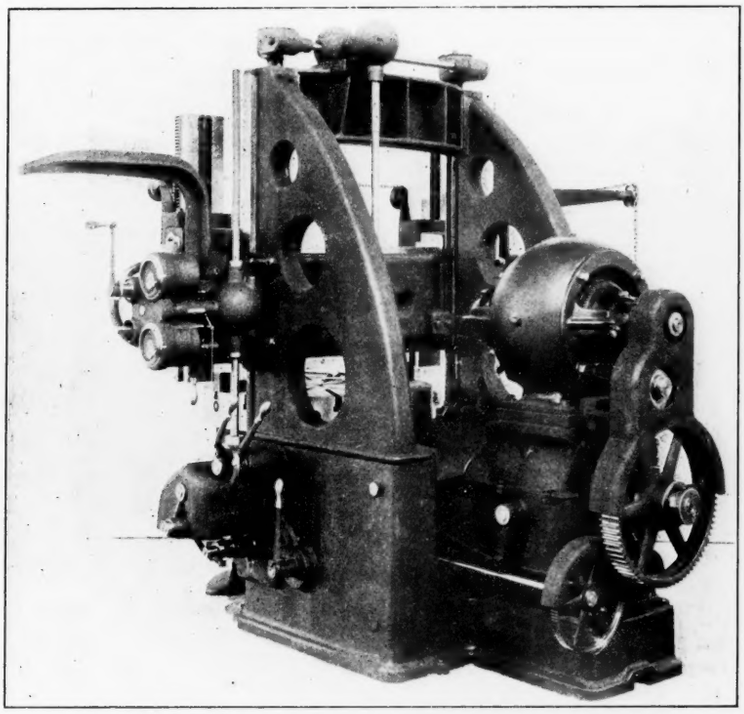


Fig. 5—Gisholt Boring Mill, Showing Motor.

of the machine is 12,200 lbs. without crane.

The Putnam single axle lathe shown in Fig. 3 is for turning both car and locomotive axles. This machine will swing 13 in. over the carriage and will take 7 ft. 6 in. between centers. A double set of driving pulleys are provided on the countershaft. This enables the use of different speeds without shifting the belt in the driving cone. The driving cone has six speeds and has an anti-friction bushing, which permits high speed service. The driving cone has steps 18 in., 22 in. and 26 in. in diameter and is driven by a 5-in. belt. The head and tail spindles are cast steel. The head is self-oiling and receives the lateral pressure on an anti-friction collar. Two feeds are obtainable for roughing and finishing. These can be thrown off or on while the machine is in motion by the lateral adjustment of the shipper rod shown on the front of the lathe. The carriage screw has a hand wheel for squaring up the ends and shoulders of the axles. The tailstock can be set to turn straight or taper and is secured to the lathe bed by three anchor bolts. It has a split binder and an oil cup and spoon for oiling the centers. The weight of this machine is 8,100 lbs.

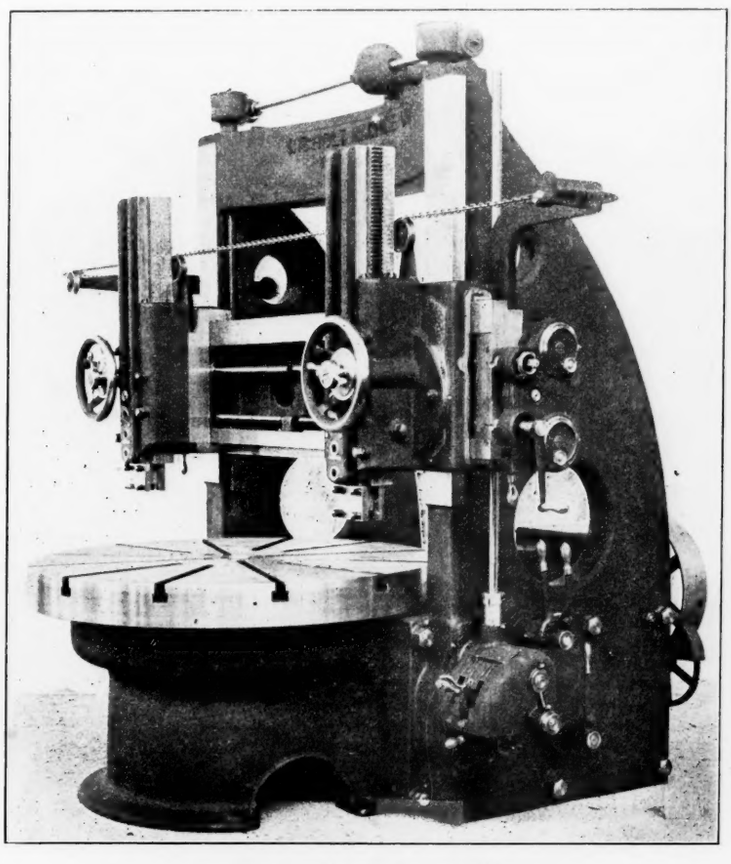


Fig. 4—Gisholt Boring Mill.

BORING MILLS.

The increasing use of the boring mill is one of the important features of modern railroad shop practice. A number of machining operations that were formerly done in lathes are now performed on the boring mill. This fact is largely due to the great improvements made in this tool in the last few years, and also to the rapidity and ease with which the work can be placed on the machine and chucked.

The accompanying illustrations (Figs. 4 and 5) show the Gisholt boring mill. The general design of the headstock is closely identified with the headstock of the turret lathe which this company makes. It is the friction type and back-geared. Six mechanical changes of speed are allowed by the headstock, and the table has 12 changes of speed. A lever within reach of the operator gives absolute control, and by reason of the friction device enables the operator to start or stop the machine without touching the motor or shifting belt. When the motor drive is used the motor is mounted directly on the headstock. This gives a close connection and one that does not necessitate any additional floor space. The cross rail is raised or lowered by power and is controlled by the lever just behind the feed-gear boxes, as shown in the illustration. The heads are independent, having separate feeds both vertical and horizontal, and each is controlled from its own side of the mill. The heads may be swivelled to any angle. Positive stops are provided so that the down slides may be brought to coincide with the table center. By a friction device in the feed mechanism any injury to the heads or gears resulting from their collision is averted. The down slides of this mill are provided with taper gibs to take up the wear. The feed screws and feed rods are fitted with micrometer index dials. These dials read to .0010 in. and reduce the amount of measuring and calipering to a minimum. By means of the feed tripping dials, which are shown at the end of the cross-rail, the feeds may be set to trip automatically at any point. A range of ten feeds is given on both vertical and cross feeds, any of which is instantly obtainable. The right-hand head may be removed and replaced by a turret head. Either the regular head or the turret head may be fitted for screw cutting, if desired. The spindle is self-oiling and rests on a beveled, babbitted surface. A spur pinion drive is used. The table may be a universal chuck fitted with movable jaws, or a face plate with independent jaws may be substituted. These mills are made in six sizes, ranging from 34 in. to 74 in.

(To be continued.)

Accounting Officers.

The sixteenth annual meeting of the Association of American Railway Accounting Officers was held at Saratoga, N. Y., June 29 and 30. It was the largest meeting, with one exception, ever held by the Association. In this organization questions arising during the year are exhaustively considered by committees of members experienced in

their respective departments before being presented to the whole body for action at the yearly meeting.

Mr. J. W. Renner, of the Pennsylvania Company, the President of the Association, opened the convention with an interesting and instructive address, speaking of the great advance in the science of railroad accounting. From what was in the beginning only the check of the receipts and the expenses of a railroad the business has developed to a well-balanced piece of machinery, showing clearly and concisely the relations of the various departments to the final results.

A committee on statistics was appointed to improve work in that field and to secure, so far as practicable, uniformity on different roads.

Four departments of the Government of the United States sent representatives to the meeting to confer with a committee of the Association on the settlement of bills for transportation of Government troops and supplies; and it is expected that improvement in and simplification of Government accounts will result.

Freight and passenger accounting methods were the subject of much interesting discussion, and the thorough reports of the respective committees were adopted and approved without much change.

The Association's plan of freight claim settlements adopted at the Denver meeting was the subject of papers by Messrs. Whitehead of the Atchison, and Dudley, of the Chicago, Milwaukee & St. Paul.

The committee on disbursing accounts has considered and reported on many questions of detail during the year.

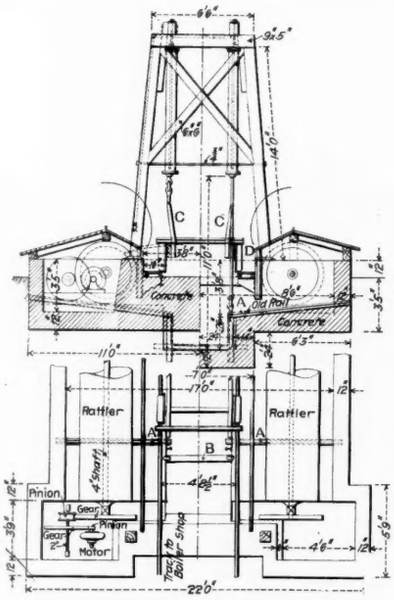
Mr. A. D. Parker, of the Colorado & Southern, was elected President of the Association for the ensuing year.

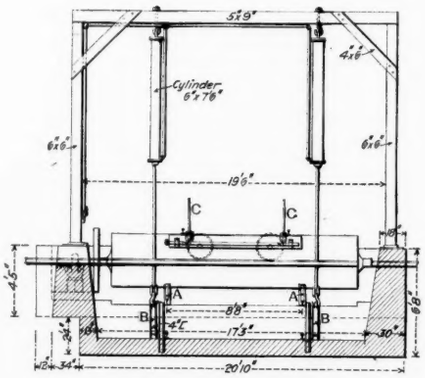
The untiring efforts of Mr. A. I. Culver, Vice-President of the D. & H. Co., in promoting the pleasure and comfort of the members and their families and in placing the services of the D. & H. Co. at their disposal for a trip to Lake George on Friday were heartily appreciated.

Flue-Rattlers at the Aguas Calientes Shops of the Mexican Central.

At the new Aguas Calientes shops of the Mexican Central the climate is such that the flue-rattlers can be out of doors all year. Noise and dust did not need to be considered, hence it was not necessary to place the rattlers under cover. They are at the end of a short track leading into the boiler shop. The rattlers are the ordinary cast-iron slat type and are placed one on each side of the track in a pit having concrete walls and bottom. The bottoms of these pits slope towards the track, with two rails, "A," to form a slide or runway for the flues. Under the track is a secondary pit, also provided with rails on the sides and bottom. Two 8-in. I-beams, the concrete at each end, span the pit lengthwise and support the rails of the track. Above the track is a framework of wood carrying four pneumatic hoists, the piston rods of which have hooks. The stroke is long enough to reach the lifting frames, "B," which are made of 4-in. channels, which rest in the center pit. Both rattlers are completely housed, with the part of the roof next to the center track hinged for putting flues into the rattler. Each rattler is driven by a 10-h.p., 500-volt, direct-current Crocker-Wheeler motor connected to the rattler by double reduction gearing. The motors and gearing are housed separately from the rattlers in a dustproof housing.

When the flues are cut out of a boiler they are loaded on a special push car having two arms, "C," on each side, held vertical by a locking device. The car is then run between the rattlers and, after the hinged roof has been raised and two slats of the rattler removed, the arms on one side are released and drop on the 4 in. x 4 in. timber, "D," forming a slide for the flues. Two cast-iron brackets, "E," inside of the housing form a





Flue Rattlers at the Aguas Calientes Shops of the Mexican Central.

continuation of these arms and permit the flues to be loaded directly into the rattler. After they are rattled, two of the slats are again removed and the rattler revolved until the opening is below and the tubes fall out. They are then dragged into the small center pit and rest in the lifting frames, "B." The push car is run out of the way, the flues lifted, the car run under them and the flues loaded on to the car by simply lowering the frames, "B." They are then run over to the racks ready for safe-ends.

The rattler was designed by Mr. C. T. Bayless, Mechanical Engineer, to whom we are indebted for the data.

The Master Mechanics' Convention.

The 37th annual convention of the American Railway Master Mechanics' Association was held in the ballroom of the Grand Union Hotel, Saratoga Springs, N. Y., June 27 to 29, inclusive. The meeting was called to order by President W. H. Lewis, Superintendent of Motive Power of the Norfolk & Western. The following officers were elected for the ensuing year: President, P. H. Peck (C. & W. I.); First Vice-President, H. F. Ball (L. S. & M. S.); Second Vice-President, J. F. Deems (N. Y. C. & H. R.); Third Vice-President, Wm. McIntosh (C. R. R. of N. J.); Treasurer, Angus Sinclair (*Railway and Locomotive Engineering*). The following amendment to the constitution was adopted:

"One representative member may be appointed by any railroad company to represent its interests in the association; such appointment shall be in writing and shall emanate from the president, general manager, or general superintendent. Such member shall have all the privileges of an active member, including one vote on all questions, and in addition thereto shall, on all measures pertaining to the determination of what tests shall be conducted by the association or the expenditure of money for conducting the same, have one additional vote for each full 100 engines which are in actual operation or in process of purchase by the road or system which he represents. Such membership shall continue until notice is given the association of his withdrawal or the appointment of his successor.

"A representative member shall pay, in addition to his personal dues as above, an amount for each additional vote to which he is entitled, as shall be determined each year by the executive committee, pro-rated upon the cost of conducting such tests as may be determined upon at each convention, provided that no such assessment shall exceed $5 per vote per year.

"Any proposition recommending the adoption of standard constructions or practice shall be in writing and be accompanied by drawings if the latter are necessary for a clear understanding of the subject. Such proposition shall then be submitted to the association for discussion, after which a vote shall be taken to decide whether the proposition shall be submitted for decision by letter ballot to all the members entitled to vote. If decided in the affirmative, the secretary, within three months from the time the vote of the association is taken on such measure, shall send by mail to each member a blank ballot, and a copy of the proposed recommendation, with a report—to be approved by the executive committee—of the discussion thereon. Such ballot to be filled up, signed and remailed to the secretary, who will count all the ballots received within 30 days from the date that they were sent to members, and he shall then announce the vote in such manner as the executive committee may prescribe. Any recommendation securing two-thirds of the votes cast shall be adopted by the association.

"All reports, resolutions and recommendations involving the use, or proposed use, by railroad companies, of any device or process which forms the subject matter of any existing patent, shall first be submitted to the executive committee, and shall be submitted to the association only by the executive committee."

The secretary's report showed that the total membership is 791 and that the balance on hand is $2,874.80.

First Day's Proceedings.

EXTRACTS FROM THE PRESIDENT'S ADDRESS.

Comparing the engines of 1868 with standard modern freight engines, we find that the boiler pressure has increased 120 per cent., tractive power has increased 296 per cent., boiler diameter 52 per cent., grate area 260 per cent., weight on drivers 272 per cent., and total weight 259 per cent. The increase

in the number of locomotives during the past seven years on the Norfolk & Western has been 37 per cent., and total increase in tractive power 79 per cent. The increase in tractive power per engine is 30.7 per cent. During this time freight ton mileage has increased 86.7 per cent. and freight ton miles per engine has increased 35.2 per cent. The freight ton miles per pound of tractive force has increased 4.23 per cent., and freight engine mileage has increased 55 per cent., the increase in average miles per engine being 13.18 per cent. The total tons of coal per 1,000 on miles is 4.09 per cent. The average cost of repairs, expressed in terms of "freight engine miles," has increased but 2.03 per cent., and repairs, in terms of "ton miles of freight," has decreased 14.96 per cent. Freight train mileage has increased 23.6 per cent., the average weight per train has increased 50.9 per cent., and average number of tons hauled per engine has increased 21 per cent. While the average tons per train has increased 50.9 per cent., the cost of repairs to locomotives, expressed in terms of "ton miles of freight hauled," has decreased 14.96 per cent.

The statement has been made by many managers that the motive power department has not kept pace with the advance in transportation, and that while we have developed a locomotive of the tractive power demanded by our managers, we are unable to utilize this power because the power of the engine is limited to the capacity of the boiler, and that the boiler is far from ample to furnish steam to utilize the tractive power. This has led to the oft-repeated inquiry, "Is the big engine a failure?" It is an admitted fact that the heavy locomotives have given very satisfactory service, particularly during the past years, and that the unprecedented increase in the traffic and commerce of the country during the past year, and particularly during the past winter, has presented problems heretofore unknown, and notwithstanding the enormous increases that have been made in the number and capacity of locomotives, and, in many cases, equally large increases in the facilities for handling traffic in terminal yards, intermediate sidings, and double tracking, the frequent congested condition at the important terminal centers has baffled the best efforts of experienced transportation officers, and much of this trouble was attributed to the failure of locomotives.

In the anxiety of traffic officials to relieve the situation, engines were loaded to their fullest capacity, and tonnage rating of trains was increased to such a point that it required the full tractive power of the engine, when worked to its full capacity, to move them, and the question of the economical point of rating for a locomotive was not considered. In place, however, of relieving the situation, this simply resulted in a further congestion by the slow movement of the train and long hours between terminals, resulting in increased engine failures, or, what should be properly called "boiler failures."

Many of our managers seem to lose sight of the important element of time and consider only the question of tons per train hauled and cost per ton mile, forgetting that the element of time was one of the most important factors in the problem of transportation. As an illustration, we will take a locomotive, the tonnage rating of which has been determined by previous tests as capable of handling 1,000 tons over the division, at a speed of 10 miles per hour, or, to express it differently, would make 10,000 ton miles per hour. If now it is desired to move a train at double the speed, or make the division in five hours instead of 10, assuming that the resistance of the train remains constant, it would require just double the power to make a speed of 20 miles that it did with a speed of 10 miles, or, in other words, it would require two locomotives of the same capacity to move the train at this increased speed. This you will recognize is an impossibility, and it is the efforts which are made to accelerate the speed of engines that are largely responsible for engine failures.

There are two committees of the American Railway Association acting in conjunction with a joint committee of the Master Mechanics' Association: First—On the subject of ton mile statistics. Second—On the subject of statistical inquiry.

The capacity of the engine to move traffic is not governed by the tractive power of the engine, but the capacity of the boiler to develop the highest tractive power possible. In the design of the boilers we are restricted within the lines of clearance of the width and length of the locomotive, so that it is not possible to design a boiler within the limit of space allowed that will develop and utilize the full tractive power as determined by the adhesion of the engine.

It was demonstrated in a test made by Professor Goss on the locomotive testing plant at Purdue University that a locomotive running at a uniform rate of 35 miles per hour with a wide-open throttle and steam pressure of 150 lbs., the coal burned was as follows:

Cut-off.	Horse Power.	Total pounds coal per hour.	Coal per sq. ft. of grate per hour.
6- inch	300	1,262	72
8- inch	434	1,978	113
10.5-inch	495	3,133	179

Let us consider what this means with one of our modern locomotives having a grate area of 50 sq. ft. If it were possible to maintain a rate of combustion of 150 lbs. of coal per sq. ft. of grate per hour, it would represent a consumption of fuel of 7,500 lbs. of coal per hour, assuming that the engine was burning the best quality of bituminous coal, containing 14,000 B. T. U., which would mean a generation of 105,000,000 heat units per hour in the fire-box. In comparison with this we will take the grate areas of locomotives with the ordinary narrow fire-box, having a grate area of 30 sq. ft., which would represent 63,000,000 heat units per hour in the fire-box. Is it to be wondered that we have frequent failures with the wide fire-box and large grate area locomotives?

It has frequently been demonstrated that in times of extraordinary freight congestion a given tonnage can be moved in less time and at less expense, and the blockade of freight has been relieved simply by a slight reduction in the tonnage rating of the train, which permitted moderately higher speeds, thereby increasing the total volume of business moved, not only without increasing the cost per ton mile, but actually resulting in a very marked decrease in cost. This cost point was admirably brought out in the excellent paper presented by Mr. C. H. Quereau at the last convention, in which reference is made to a paper by Mr. Wm. Bennett on the subject of economical trade load, based on an experiment showing the effect of change in tonnage rating. It was shown that a reduction of five cars from a 45-car train reduced the average time of trains on the road five hours per train, which in 30 days resulted in an increased movement of freight from 26,160 tons to 31,104 tons, and an increase in revenue from $23,544 to $27,993.60, which represented total increase of $4,449.60 in favor of the 40-car train. While we must admit that such questions will have to be considered by each road individually, yet I think that the association should inaugurate a general investigation which will direct attention to the vital character of the problem and indicate in a general way the principles involved, and I recommend that it be one of the subjects for investigation and report at the next convention.

The past year has brought remarkable progress in machinery, tools, and shop equipment. This has found its greatest development in commercial establishments, but we have been busy in applying the improved practices in our locomotive and car shops. We are, however, only beginning to develop in this direction, and there is much to be gained by applying methods for increasing production and improving shop methods.

Much is being said and written concerning the conflict between electricity and steam. Electricity is said to be about to drive steam out of the field. I see no conflict whatever. I recognize that electricity can do certain things better than steam, and that it will gradually extend its field to meet new requirements which steam cannot reach. There is no occasion, however, for any anxiety or any fear of conflict, but rather we should receive it with open arms. In shop practice it has worked wonders and bids fair to revolutionize some of our present methods and equipment. The days of long line shafting, isolated steam engines and boiler plants are fast disappearing, and their places are being taken by central power plants, central electrical plant and systems of power distribution. This has brought our power cranes within reach of all departments, serving as an ally to the labor-saving methods by the use of compressed air, and opening up an entire new field in machine tools. Machine tool builders are trying to meet the advanced methods of designing and bringing their products up to sufficient capacity of the variable speed motors. These tools in combination with high speed steel are rapidly changing shop conditions and practices. Years will pass, however, before the steam locomotive will give place to electricity, but that it may do so in the future is not beyond the range of possibility, as indicated by the rapid advance which has been made in New York city and other places. The extension of its use will be gradual, and many new problems will appear in connection with electricity, and they are being slowly worked out. They can best be met by men of experience. It behooves us, therefore, to look out that the development does not pass into other hands, or some one some day may write of the "passing of the master mechanic."

I wish to impress upon the younger men who are before me to-day these opportunities, which they must not lose. The members of this association must look deeply into electricity as we now have it, for there is surely more to come in the future. The development in electricity is not like that of the locomotive, an evolution, but the rapid development constitutes rather a revolution which finds the average mechanic of to-day totally unprepared to meet it. The demands of the future will require a knowledge other than that possessed by the locomotive and car builder of to-day; it will require a combination man, not only capable of meeting the demands upon him for construction and maintenance of cars and locomotives, but a full knowledge of electricity as a motive power. I see no reason for fear of a conflict between electricity and steam, but rather an inducement for the mechanical man to familiarize himself with the principles of electricity as a motive power, and thereby fit himself to become the combination man.

I desire to call attention to the apprenticeship question: There is no lack of good advice from this association as to the proper

methods for the advancement of the apprentice, with a view of recruiting from their ranks. Little, if anything, however, has been done in a practical way. It is all very well to provide facilities for intellectual and educational advancement, and a progressive system of instruction through the various branches of mechanical work, but we should also impress upon them the understanding that their employer is their friend, and that the surest road to advancement lies in the path of loyalty and industry, by drawing from the ranks of the worthy employes to fill positions of trust and responsibility. We can assure these young men that their opportunities for advancement from the ranks to official positions are greater to-day than ever before.

The president of the Master Car Builders' Association, in his annual address, proposed the consolidation of the two associations, and while this has for a number of years been a subject of discussion, it has never before been brought forward with the official support of the Master Car Builders' Association. There are many good reasons for a consolidation, and I can see no objection. I would recommend that the executive committee of this association be instructed to confer with the executive committee of the Master Car Builders' Association with a view of treating in a spirit of cordial co-operation the proposal of consolidation of the two associations.

On invitation of the President, Mr. W. J. Johnson, Mechanical Superintendent of the Bombay & Central India, made a few remarks. He said he had traveled 11,000 miles to attend the convention. He paid a tribute to the excellent work done by the association.

TON-MILE CREDIT FOR SWITCH ENGINES.

(Reported elsewhere in this issue.)

Mr. William McIntosh (C. of N. J.): The committee has solved the problem nicely, and has adopted the only means of arriving at the value of a switching engine. I take exception, however, to the suggestion that the total weight be used. There are many road engines still switching, so that it is not wise to take the total weight, but rather the weight on drivers.

Mr. E. W. Pratt (C. & N. W.): A great many of the roads in the East have a larger proportion of switch engines proper in service than those in the West, and the weight on drivers is as readily obtained as the total weight of the engine. Switch engines in gravity yards will, however, be benefited. The same engine will probably switch more cars in a gravity yard than where the yard is level, but perhaps that will offset the amount of fuel burned and the wear and tear on the engine, as compared with a level yard.

L. R. Johnson (Canadian Pacific): There are switch engines in service which have a truck sometimes in front and sometimes in the rear, and it would not be wise to record the work of that engine by its weight on the drivers. The fairest way of reckoning this ton-hour system would be by taking the total weight of the engine, exclusive of the weight of the tender. In our accounting departments we are following the general line of ton-mile statistics. When the statistical departments take up our work it will, of course, have to be understood that the switch engines should be taken entirely apart from the performance sheet of our general road engines, because we put our road performance sheet on a different basis. One class follows the ton-mile basis, and in some cases the ton-mile-hour basis, and now we propose the ton-hour basis.

R. H. Soule: It is possible to find a factor by which the engine-ton-hour could be converted approximately into train ton-miles, and with such a factor you could bring statistics down to a uniform basis. The converting factor would probably be about 200; that is, for each ton-hour of engine service you are really doing about 200 ton-miles of train service.

George L. Fowler: The weight on drivers or the weight of the engine is a simple figure. To take the tractive power of the engine would have been the same thing, although to have taken the ton-mileage basis would have simply added another factor which the association would have been obliged to agree upon. The object in presenting this system was its simplicity. A ton-mile basis is simply adding another factor in the multiplication.

David Brown (D. L. & W.): If you decide on the ton-hour, it should be the average ton-hour of all the engines on the system, not the engines of the same weight.

George L. Fowler: The idea in giving the weight of the engine was in order to give a road that had heavy engines credit for more work than is done by a light engine.

G. R. Henderson: Mr. McIntosh made suggestions in regard to using the adhesive weight instead of the total weight, and the members of the committee who are here present think that suggestion was a fair one. On a road that has a gravity yard, the cars which can be handled depend on the amount which can be pushed uphill, and the engine can hardly take more cars down hill than can be pushed uphill. I offer a motion that the report be changed so as to mean the weight as represented by the *adhesive weight* of the engine. (The motion was carried.—Editor.)

GRATES FOR BITUMINOUS COAL.

(See Railroad Gazette, July 1, p. 114.)

G. R. Henderson: I do not know what some of our Western roads would do without the use of netting over the air openings, especially in dry seasons and in countries where there is very little water. On these roads it is always customary in the summer time to use a netting over the damper openings to prevent the fire from spreading.

J. A. Carney (C. B. & Q.): Our reason for doing away with the netting is that it cuts down the opening area about 50 per cent. The practice on our road is to use netting where there is liability of fire falling out. Some recent designs have a deflector plate, which allows the ashes to fall on the plate and then drop down inside the box. Another objection to the use of netting is that it clogs up.

John Player (American Locomotive Company): It is proposed to make the openings in the ash-pan 25 per cent. of the grate area. The air opening of the ash-pan should be based on the flue area, instead of grate area. The proposed grate shows a conventional form of central bearing bar which is very wide, and which must be kept clean in order to work perfectly. A simple way of overcoming that can be done by making the trunnion pockets in the grate rockers instead of in the bearing bars. In that way the central grate frame can be narrowed to 1½ in., thus avoiding clinkering.

COAL CONSUMPTION OF LOCOMOTIVES.

(Report elsewhere in this issue.)

G. R. Henderson: Some roads have a system of examining firemen every year, which has advantages over waiting for three or four years when they are ready to be enginemen. If you wait until they have served their full apprenticeship of three or four years, and then make an examination, you find they are poor material, and that you have therefore wasted time with them. On some roads when the fireman is employed he is given a small book of questions, and is told that at the end of the year he will be examined on those questions. If he is not able to pass that first year's examination he is not considered a satisfactory employee; but if he passes with a certain definite percentage (60 or 70 per cent.), he is given further time to perfect himself. If it is shown that he has given attention to the questions he is carried on a second year and given another book, and if upon the second examination he shows efficiency in his knowledge of the contents of the book, he is carried on a third year. The third year gives him the final examination on which his promotion depends. If he passes that examination he is eligible to promotion as soon as a vacancy occurs.

Prof. W. F. M. Goss (Purdue University): It is rather significant that the report does not make a very great argument in favor of the large grate. The results obtained, so far as the amount of coal burned for a given amount of work done is concerned, are substantially the same with the large grate engines as with the small grate engines. If we attempt an analysis of that fact we shall find the important saving which is made by the use of the large grate comes from the reduced loss of cinders and sparks through the stack, but that loss is in part offset by the greater skill which is required in firing the wide-grate engines. It is essential to good results that an even fire be kept and that the excess air be regulated or controlled. With a large-grate engine it is difficult at times to prevent the ingress of air which is beyond that required for combustion, which absorbs heat from the furnace and passes on through the tubes.

Prof. H. W. Hibbard (Cornell University): The large locomotive, with the big fire-box, has emphasized the shoveling of much coal, and a number have spoken about men of muscle and no brains. The man that does not have quite so much muscle but that has a whole lot of brains, so he knows how to use his muscles to the best advantage, is the man that succeeds when the big muscular man that has no brains fails. You have got to teach the men that simply shoveling in tons of coal is not making steam, but that coal has got to burn, and it is not only the carbon in the coal that has got to burn, but the hydro-carbon gases that come from that coal.

H. A. Gillis (American Locomotive Company): What we have lost for some years has been the instruction of the fireman by the engineer. On a big engine the fireman is away from the engineer, and there is no one to help him.

W. R. McKeen, Jr. (Union Pac.): The most important feature of coal economy is the statistics which we have. Most roads seem to be measuring the coal by coal pockets, some by individual coal chutes. But that gives us very little check on the individual performance of the engine, and very little check on the individual performance of the fireman. We should equip our coal chutes with a weighing device, and get the exact number of pounds of coal consumed over a division, and convert that into ton-mile statistics on some basis, as, for instance, an individual fireman's basis, which can be handed to the traveling engineer or the traveling fireman.

S. W. Miller (P. R. R.): The one subject of round-house attention has more to do with the successful operation of locomotives than any other one thing. It is difficult at some round-houses to properly care for large

engines. It is also harder to renew packing rings in a 22 in. x 28 in. cylinder, where the cylinder head weighs 300 lbs., than in the case of lighter engines. It takes three men, where formerly one man was used. The transportation department expects us to turn these large engines out of the round-house in the same time as it takes for the smaller engines.

LOCOMOTIVE FRONT-ENDS.

(*See Railroad Gazette, July 1, p. 107.*)

The executive committee was authorized to appropriate at their discretion such funds as are necessary to carry out experiments outlined in the report.

TOPICAL DISCUSSIONS.

For lubricating main side rods and driving-box bearings, which is the better practice, grease or oil?

F. F. Gaines (Lehigh Valley): This question should not be considered solely from the intrinsic value as a lubricant of the two articles in question, but rather from the relative economy that is to be obtained by their use. While theoretically to prevent friction, the thinnest possible lubricant that will run cool under all conditions should be used, there are other points to be considered. It is maintained that suitable grease can be made, which has little, if any, greater viscosity than oil when in use. Even granting that the grease has a greater viscosity, and that there is some initial heating due to its use, this is more than offset by the fact that the use of grease is cheaper, very much more reliable and cleaner.

Engines that are equipped for grease in all rod bearings will make 100 miles to ⅛ lb. of grease, against at least one pint of lubricating oil. With grease on all the heavy engines on my division, there has not been a single hot pin. The visible part of the machinery, instead of being spattered with oil and caked with dust, comes in nearly as clean as when it goes out, as the grease is only fed as required.

M. K. Barnum: I made some experiments on the Union Pacific with grease in rod cups, and an 8-wheel passenger engine ran 30 days on one filling of the rod cups. It would have been necessary to have filled the cups at each end of the road, if not in between the terminals, on each trip, if free oil had been used.

W. G. Wallace (D. M. & N.): At one time we fitted up an engine for grease on one side and the other side with oil. After making 45,000 miles we took the engine in for repairs, and we did not find that either the pins or the brasses showed excessive wear on the side where the grease was, but in fact it was less.

D. Meadows (M. C.): We have a class of engines in which the percentage of babbitt in the main rock brasses was very large, and we found that in using the grease the babbitt would not hold out. It was necessary to change the brasses and put in solid brasses, doing away with the babbitt entirely. The grease practically cuts out engine failures from hot brasses altogether.

With the large modern engines equipped with power brakes, is not screw reverse mechanism preferable to present hand-lever arrangement, and is quick reversal a vital consideration?

John Player: The American locomotive engineer is at present not able to accept a screw mechanism. A screw reverse gear would be troublesome and awkward. In case of emergency, it would probably cause confusion. Furthermore, the lever mechanism is simple, easy of application, and takes up little room in the cab, especially on large engines that have the lever alongside of the fire-box. The screw gear is cumbersome.

David Brown (D., L. & W.): The lever and the screw are both wrong. We ought to have an arrangement to work the mechanism by power, using either air or steam.

D. Meadows (M. C.): The reverse lever is one of the best indicators to the engineer if his valves are being lubricated properly. That would not apply to the screw gear. If the engineer is in doubt whether the valves are being fully lubricated, he simply unlatches the reversing lever.

What is the best practice with reference to providing air spaces under locomotive grates, especially with wide fire-box locomotives?

F. J. Cole (American Locomotive Company): The ashpan is merely a receptacle for containing the ashes and should not be constructed so as to interfere with the free admission of air. It is usually arranged with dampers so that the admission of air may be regulated, but the operation of these dampers is not generally observed by railroads, consequently the openings are very often left without dampers. Air openings cannot be too large. That is, no injurious effect follows so long as there is a fire and the grate is covered with coal. But on the other hand there may be insufficient openings for the admission of air for the proper combustion of fuel.

Because all the gases must pass through the stack it does not follow that ash pan openings equal in area to the stack will give the best results. The draft in the stack has a high velocity and the smoke-box vacuum varies from 2 to 6 in. of water. The vacuum in the fire-box should be much lower and as free air admission provided as possible. If there is any doubt as to the proper openings to provide, the total flue area is suggested as a convenient base. It seems unnecessary to exceed this in any case. In many cases very free steaming engines can be cited which have about 75 per cent. flue area for ashpan openings. Of course, care should be taken to arrange the openings so that they are not obstructed on the outside by braces, plates, etc., and on the inside by accumulations of ashes. It is often difficult to provide enough openings in front or back or on the sides which will not be partially choked as the pan fills up.

This is especially true of wide fire-boxes and for that reason the best results have been obtained by making the side openings directly under the fire-box frame, these openings to be 3 or 4 in. deep and extend along the length of the fire-box. The side openings underneath the fire-box ring not only afford free admission of air, but also good facilities for readily clearing off the slopes of the ashpan of ashes and cinders which may accumulate and bank up under the grates.

The air openings in deep ashpans can often be advantageously made in the sides about 20 in. or over from the bottom and covered with netting to prevent the escape of hot cinders. These can be further protected by using a sloped solid plate extending the full length of the opening at the top, about 3 in. wide at an angle of, say, 45 deg., to further prevent the hot ashes from passing through the netting.

Openings in front, when unobstructed, are desirable and it seems advantageous to provide all the openings in the front of the pan which are possible, supplementing them with side and back openings to provide the required area. With an engine moving rapidly the air will flow in through the front openings at a higher velocity than at the sides or back.

Prof. Goss: One view of the ashpan problem might well embrace the whole apparatus which controls the movement of air from the outside atmosphere through the mechanism of the engine and back into the air. There is first the front-end, then the flues, then the grate, and then the ashpan. Now, this movement is stimulated by the action of the exhaust jet, and evidently if any one of the elements is unduly constrained, then the exhaust jet will be called upon to do more work. If the opening in the ashpan is small, we must compensate for that small size of opening by doing a larger amount of work with the exhaust jet. Evidently the tube area we cannot change materially. That is a factor which is fixed by the general design and proportions of the engine, and we must make our draft act through the tubes at whatever cost, but we do have very great freedom in controlling the opening in the ashpan.

What is the best method of caring for locomotive front-ends?

W. O. Thompson (N. Y. C.): The following method is used by our road: The material used is Walker's smokestack black, thinned with Sipe's Japan oil, in proportion of one part Japan oil to two parts of stack black. It is very quick drying, has considerable elasticity, with a deep black color, has good wearing qualities, and when it does scale, the tendency is to all scale off instead of in spots. The cost of labor for applying on our large locomotives is 17½ cents each. Quite a saving can be made and the appearance of the engines generally can be improved if the painting of the front-ends be under the supervision of the engine inspector or the man who has charge of the work in the engine house.

W. McIntosh (C. of N. J.): I notice a disposition in using any kind of coating for a locomotive front end to spread it on too thickly. I find the best results can be obtained by coating the surfaces sparingly, usually with a brush, rubbing on just enough to moisten the surface.

J. F. Walsh (C. & O.): Graphite rubbed on thinly and frequently, and preferably with a little towel, dampened and then dipped in, or the graphite sprinkled on, gives us the very best and prettiest front-end that I have seen anywhere. It costs comparatively little and it doesn't scale.

F. A. Chase (C., B & Q.): About a year ago we commenced using a mixture of one pound of flake graphite, one pound of white lead and one pound of boiled oil, and with the pooled engines we have a man that takes care of the front ends and the smokestacks, and he puts a very thin coat on. Where a very thin coat is put on with the brush an engine will run from five to ten days without recoating, and it has cost on an average about nine cents to coat the front end of a large engine.

Packing for air pumps for high speed brakes.

A. J. Cota (C., B. & Q.): It is generally considered by air pump repair men that there are three essential points to be observed in order that good service may be gotten from any piston rod packing. (1) The air and steam cylinders must be in perfect line. (2) The packing in piston heads must make a perfect bearing on the walls of the cylinder during the entire length of the piston stroke. (3) That the piston rod must be true and well lubricated.

Very good results have been obtained by the use of a swab nicely fitted around the piston rod in conjunction with an oil cup fastened to the air pump by one of the center-piece bolts and fitted with a quarter-inch pipe, which would allow oil to drop directly on to the swab. In making the swab a piece of thin sheet brass was first formed so that it would encircle the rod at a loose fit. Lamp wicking was then wound around the brass ring and after being saturated in oil was forced in place on the piston rod. This brass

spring can be made of such depth that when properly wound with wicking and forced in place, it will effectually prevent the piston rod gland nuts from working loose.

I have made a number of tests with different makes of metallic packing and different kinds of soft packing, taking care that each kind should receive thorough attention and the best results were obtained from the metallic.

The advisability of reducing the diameter of stay-bolts and shortening the space between the stay-bolts proportionately.

G. R. Henderson: In order to find out just what would be gained by making reductions in size and spacing, I have prepared a tabulated statement showing the results of some simple calculations made upon the subject. This assumes a 1-in. bolt as a reference base, and the computations have been worked up for 1, 7/8, 3/4 and 5/8 in. stay-bolts.

Comparison of Stay-Bolts.

Nominal outside diameter, inches.	Approx. diam. at bottom of thread, ins.	Approx. area at bottom of thread, 00. in.	Pitch for 5,300 lbs. strain at 200 lbs. pressure, inches.	Per cent. metal left in sheet.	Proportion of bending strain to 1-in. diameter.	Reduct'n in bending strain to 1-in. diameter, per cent.	Length bet. sheets for same reduction with 1-in. bolt, inches.
1	7/8	.601	4	75.	1.00	00	4
7/8	3/4	.442	3 7-16	74.5	.86	14	4 5-16
3/4	5/8	.307	2 7/8	74.	.71	29	4 3/4
5/8	1/2	.196	2 1/4	76.3	.57	43	5 1/4

From this it appears that if we lengthen the stay-bolt by increasing the water space, we will reduce the bending strain even if we maintain the same diameter of bolt. Recent practice has caused this increase in length, though for another reason, namely, to provide more water next to the side sheets, in order to prevent their rapid destruction by the severe heat of the fuel. If we consider that the distortion of the stay-bolts by expansion increases with the distance from the mud ring, where the inside and outside sheets are securely tied together, we come to the conclusion that at the bottom of the water leg we can use standard bolts and spacing, but as we rise from the ring, the bolts should be smaller (and closer) or longer, in order to prevent an increase in bending strain. There is comparatively little trouble with stay-bolts within 2 ft. of the mud ring, so that if we admit that a 1-in. bolt can be safely used at that height, and the fire base be 5 ft. high, we can determine the length of the top bolts. We found in our analysis, that the strain was directly proportional to the deflection (or expansion of the inside sheet), so at 5 ft. from mud ring, it would be 2½ times as great as at 2 ft. This would call for a bolt considerably less than 5/8 in. diameter, which would not be considered. The increase in length is however, practicable. As the strain and length vary inversely as the first power of the former to the second power of the latter, we can figure, from a 4-in. length at 2 ft. above the mud ring, and find that if stay-bolts give no trouble when 4 in. long, 2 ft. above the mud ring, the same size bolt, 6½ in. long, 5 ft. above the ring, should also be free from breakage. Modern designs very nearly fulfil these conditions, as far as vertical deflection is concerned. The question of horizontal bending is not so easily adjusted, but we believe that most stay-bolts are broken by vertical deflection.

The spacing must be considered in connection with the proper cleaning of boilers. If the bolts are too close together it will be extremely difficult to get out the mud and deposits; this is worse at the bottom of the water spaces where, fortunately, the bolts need not be so closely assembled to make up for reduction in size, but this cleaning is important at every point and we believe the increase in length is better than the decrease in diameter and spacing. It is often necessary to insert studs in the outside sheet between stay-bolts, to secure pads, etc., and the close spacing would be detrimental; the additional cost of applying and inspecting a greater number of bolts must also be considered, so that taking cognizance of all these points, we are inclined to believe that the increase of length is better than decrease in size and pitch.

F. J. Cole (American Locomotive Company): In considering the relative diameter of stay-bolts and spacing, it is always necessary to analyze the question in all its bearings. It is usually arranged that the tensile strength on any bolt of given diameter is the same, but when you consider the strains on the outward bolts, the vertical rows, which are the bolts which nearly always break out first, you will find the smaller bolts are always very much overloaded, and so far as we are able to ascertain, it requires a bolt of a certain diameter to withstand that strain.

Second Day's Proceedings.

On motion of Wm. Forsyth, the recommendations contained in the president's address were referred to the executive committee for proper action.

TOPICAL DISCUSSIONS.

Leaky flues in wide fire-boxes.

M. K. Barnum: Leaky flues in wide fire-box locomotives are due more to improper firing and to bad water than to any peculiarities of design. Holes in the fire allow cold air to pass through the grates, and as this is most apt to occur at the front end of the fire-box, the cold air strikes the flue sheet and ends of the flues, causing them to contract unequally and leak.

In some wide fire-boxes the mud ring is made with an angle near the middle of the sides for the purpose of dropping it down at the front to clear the driving wheels and to obtain more space between the grates and bottom row of flues, but even with this arrangement the lowest flues are often not more than 10 to 15 in. above the grates. This leaves a ridge in the grates across the middle of the fire-box and forms a pocket at the front, which the fireman is very apt to overload with coal.

Brick arches afford protection to flue sheets from cold air, and this may cause an apparent difference as to leaky flues in favor of narrow fire-boxes. With equally good water and proper firing and the same length of flues, wide fire-boxes will not give much, if any, more trouble than narrow fire-boxes.

G. R. Henderson: It is generally thought that waters which contain much incrusting matter give the most trouble from leaky flues; but some of the Western roads have come to the conclusion that foamy waters are as bad as incrusting waters.

F. C. Cleaver (Rutland): It is better to get too much coal against the flue sheet than not enough, the idea being to check the air from coming close to the sheet.

J. H. Manning (D. & H.): We have about 225 engines with wide fire-boxes using anthracite coal, and we wash our boilers out about every 25 to 30 days. Our flues last from two to four years. The thing to do to prevent leaky flues is to take care of the feed water.

G. R. Henderson: Feed water, no doubt, is very largely responsible for leaky flues, but you do not get rid of all your troubles by treating your water. If the water contains carbonate salts, carbonate of lime, and magnesia, it is very easy to get rid of that, but if water contains sulphates of lime and magnesia, when you introduce soda ash it leaves a residue of sulphate of soda, which is a foaming material. It is possible to convert an incrusting water into a foaming water, and it is this foaming water that in a great many cases is as destructive to engines as the incrusting water.

H. H. Vaughan (Canadian Pacific): We have had lately success with arches against the sheet to keep cold air from passing across the flue sheet, but the arch became stopped up with cinders on the top. To overcome that we ran the face brick close against the sheet for about a foot, then left an opening 6 in., then continued the arch. That gave a chance for the cinders to fall out and yet didn't leave opening enough for much cold air.

J. F. Walsh (C. & O.): We are having two Pacific type engines built with flues 19 ft. 6 in. long, and bowed up an amount equal to their diameter to allow for expansion and contraction.

H. T. Herr (N. & W.): With engines of similar capacity, the wide fire-box engine has less fire-box heating surface than the narrow fire-box engine, which requires a higher duty of the flue heating surface in the wide fire-box than in the narrow. This results in a greater tendency to cause fluctuation of temperature in the wide fire-box than in the narrow.

Limit of width of soft coal burning fire-boxes with reference to high evaporative efficiency.

Lawford H. Fry (Baldwin Locomotive Works): The wide fire-box for soft coal is a necessary result of the modern demand for large locomotives. The reason, of course, for widening the fire-box is to obtain sufficient grate area without increasing the length beyond the point at which the grate can be easily fired. There are two extremes which have to be avoided in designing a fire-box. If the combustion is too rapid, the draft carries a large proportion of fuel through the flues and the engine gives a low economy. On the other hand, if the grate is made too wide, the fire will be too light and excess air is carried through. The evil of this excess air has been forcibly brought to our attention. We have found that some locomotives when taking a 13-car train would burn 85 lbs. of coal per sq. ft. of grate, and would evaporate 7 lbs. of water per lb. of coal. When they were working with a 10-car train, the combustion was cut down to 75 lbs. of coal per sq. ft. of grate and the evaporation was cut down to 6 lbs. of water per lb. of coal; the difference being due to the excess air which was carried through the fire.

If we take ordinary soft coal, burning at 120 lbs. per sq. ft. of grate per hour, and admit sufficient air to produce 20 lbs. of gas per lb. of coal, the fire-box temperature will be about 1,800 degs. and the loss in the smoke-box about 23 per cent. of the total heat produced at the grate. If, now, the rate of combustion be decreased to 100 lbs. of coal per hour, the air supply being increased to give 30 lbs. of gas for each lb. of coal, the fire temperature will drop to about 1,260 degs., and the loss in the smoke-box will be increased to 35 per cent. In the first case a pound of coal evaporates 7.4 lbs. of water, while in the second case it would only evaporate 6.3 lbs. of water. This reduction in efficiency is due to the greater volume of the gases from the fire, which carry away a greater amount of heat. There is also a loss by reason of the lower fire-box temperature, as the absorption of heat is less rapid from the low temperature gases than the high temperature gases.

Of course, it may be argued that the fire-box could be made wide and the draft adjusted so as to give the proper amount of air, but it must be borne in mind that the locomotive is not always working at its maximum efficiency. We may design the draft to give an economical rate of combustion at the maximum efficiency, and then when the locomotive is light-loaded the fire will be so light

that the draft will take through an excess of air. It is desirable to have the inside sheets of the fire-box vertical, so that the steam which is generated rises in a narrow sheet, up past the fire-box sheets, and does not mix in with the steam in the water space. If the sheets slope inward the steam rising vertically from these sheets mixes in with the water and interferes with the circulation.

DRIVING AND TRUCK AXLES AND FORGINGS.

(*See Railroad Gazette, July* 1, *p.* 114.)

This report was read by Mr. L. R. Pomeroy (General Electric Company). He called attention to a special drill used by J. F. Kincaid (American Locomotive Co.), for removing test specimens from axles. Mr. Kincaid showed the drill and a test specimen, and said that a specimen could be got in 20 to 40 minutes from hard steel and in 20 minutes from soft steel. Mr. H. A. Gillis (American Locomotive Company), thought some means should be provided for determining "piping." Annealing of axles should also be required.

The committee was continued and the subject held open until after the meeting of the International Railway Congress next spring.

BOILER DESIGN.

(*See Railroad Gazette, July* 1, *p.* 109.)

After some discussion of the report a resolution was passed authorizing the executive committee to raise a fund not exceeding $5,000 to be used under the direction of a special committee for conducting experiments concerning important features of boiler design.

TECHNICAL SCHOOL GRADUATES.

(*Paper elsewhere in this issue.*)

H. A. Gillis (American Locomotive Company): We have a tendency to forget that most young men who have gone to technical schools not only have the theoretical training, but they also have a considerable practical training, and that they are sometimes quite as expert as the older mechanics who have learned their trade in the shop. Every apprentice ought to be given credit for knowing something before he starts into the shop, and he ought not to be rated down at any such rate as 10 cents an hour. Every fellow that comes out of a technical school is not going to make a foreman. He may not have the slightest conception of how to handle men. Yet such a fellow may have splendid abilities along some other line. He may make a fine engineer of tests.

R. H. Soule: The technical graduate has been to the technical school perhaps four years, and he has done sufficient while there to ground himself in the fundamentals of engineering, and when he graduates and chooses railroading as his specialty, his education should continue for a while longer on that same general line. If he chooses the motive power department he should get an all-round knowledge in that department, and therefore the method which is usually in vogue is really preferable to the one suggested. It is surprising that the railroads have got as many technical graduates as they have, because as a general thing they put them down among the ordinary apprentices, and at the same wages.

W. McIntosh (C. of N. J.): We should give the technical graduate credit for the practical training acquired at college, some of them gathering what is equal to an ordinary apprenticeship during that time, coming out practically equipped to go into the shop and give as good a return as many mechanics. I take no stock in the systematic training of the technical graduate, that is, placing him in a shop and letting him go through a certain course. I do not believe that that amounts to nearly as much as to turn him loose in the shop and say, "Here, we will give you an opportunity to go in there, and if you develop ability we will pay you reasonable wages and give you a standing in the line of promotion."

TERMINALS FOR LOCOMOTIVES.

(*See Railroad Gazette, July* 1, *p.* 115.)

H. H. Vaughan (Can. Pac.): We are going to cover a 20-stall roundhouse this year to see if it will not improve the roundhouse conditions, and in doing that we are taking an old 20-stall roundhouse and taking the depth of the truss from the roundhouse roof, which will give us 6 ft. of light all round the curvature of the house, and put a high roof in the center, which costs about $700 a stall, so that the cost is not serious in comparison with the advantages. We can keep it fairly ventilated.

Third Day's Proceedings.

IMPROVED TOOL STEELS.

(*Paper elsewhere in this issue.*)

F. F. Gaines (Lehigh Valley): In my experience few, if any, machines built previously to the last three or four years are capable of giving maximum output. If you attempt to drive the machines to the capacity of the steel, the gears break, the spindles break, the bearings run hot, etc. Up to capacity of the machine, high speed tool steel has made a radical change in all shop methods of machining.

W. O. Thompson (N. Y. C.): I have been using high speed steel for both finishing and roughing, and it is as good on the finishing cut as it is on the roughing cut.

M. K. Barnum: A good grade of steel of a lower value in price than the alloy steel will answer all the requirements for finishing.

C. A. Seley (C., R. I. & P.): It does not seem to pay to use expensive steel in cases where the cheaper steel would do the work. Undoubtedly, when tools are worn in size, but still retain the properties which will permit of their high speed use, there are a number of special holders on the market which will enable us to use a piece of steel down to a very small point.

Wm. McIntosh (C. of N. J.): We are not giving the necessary attention to tool holders. In other words, we are using full blocks of steel when with a special toolholder we could reduce the size very much. In that manner we could carry a liberal supply of finished tools on hand, and minimize the amount of time lost in traveling back and forth to the grindstone.

PAINTING LOCOMOTIVES.

(*Report elsewhere in this issue.*)

Mr. A. P. Dane (B. & M.) in opening the discussion called attention to an error in the report and asked that the phrase "the material-saving paint sprayer" be struck out.

The report was accepted by the association.

AUTOMATIC STOKERS.

(*See Railroad Gazette, July* 1, *p.* 109.)

F. Walsh (C. & O.): On account of the limited number of these devices on the market, we have had to confine ourselves to the one stoker. In our experience with the stoker, we find that it reduces repairs to flues. We have run a 22 in.x28 in. consolidation engine for three weeks without making any repairs to the flues. We have had the stoker on some large passenger engines, and the engine will go from one end of a long division to the other with practically no variation in the steam pressure. The service in which we find the stoker most valuable is on the long fire-box engine running over a long division, pulling from 2,500 to 3,500 tons of freight, where the fire-box door would be opened two-thirds of the time. We have given you the capacity of the stoker as it would ordinarily be fired; but it can be increased almost double by throwing the coal, instead of depending upon the screw.

P. H. Peck (C. & W. I.): Our engines are getting bigger every day, burning more coal, but the men are not any bigger than they were 20 years ago. We have got to come to some mechanical stoker in the near future.

Prof. W. F. M. Goss: We should not expect to get any large increase in efficiency from the application of a stoker to a locomotive, because history shows us that we have not obtained any large increase in efficiency by the application of stokers to stationary plants. There are certain conditions which have to be met in stationary service where stokers are used that are not found in locomotive service, and which will make difficult the application of those types of stokers or automatic furnaces which are used in stationary service. Thus, with a chain grate, or with other forms of stokers used in stationary boilers, it is essential that there be no very sudden changes of load upon the boiler. It takes a given time for the furnace to respond to a change in condition, and of course the locomotive stoker must respond promptly to changes in condition.

The stoker described is more an automatic shoveler than a stoker. Instead of putting the coal into the furnace a scoopful at a time, it puts the coal into the furnace a fraction of a pound at a time, and it spreads it perfectly, and because it goes in a small quantity at a time and is well distributed, we get freedom from smoke. The apparatus is the sort which we must look to for success in the automatic firing of locomotive boilers.

F. F. Gaines (Lehigh Valley): You cannot properly cover an anthracite fire automatically. It is all right for soft coal, or in a narrow fire-box, but, with a wide fire-box, combustion is constantly changing from one portion of the box to another.

J. F. Walsh (C. & O.): I have seen the stoker set in the door opening of a room 10 ft.x11 ft. and it would distribute the coal level over the entire surface of that floor. There is no question as to the stoker being capable of distributing the coal evenly.

H. T. Herr (N. & W.): A skilful fireman can fire just as well as a stoker, but he cannot endure the work as long as he could if he had the stoker. That is the important feature of the stoker.

Max Toltz (Canadian Pacific): I had an opportunity to probably make the first test with the stoker on the Great Northern in 1902. We did not find any coal economy. The apparatus was installed on a consolidation engine, about 165,000 lbs. on driver, narrow fire-box, 120 in. long. The economy was in boiler repairs. The engines were running on our bad water district, in North Dakota. We did not have as many leaky flues and the roundhouse work was reduced considerably. The main object of putting on the stoker at that time was to save the hard work the fireman had to do.

LOCOMOTIVE FRAMES.

(*See Railroad Gazette, July* 1, *p.* 113.)

Wm. McIntosh (C. of N. J.): The ordinary frame has too many bolts in it. We should eliminate these bolts, if possible, and make each frame as nearly as possible one homogeneous mass. In 1900 I had some frames designed for a Mogul engine, without any joints in it. They have run with entire satisfaction.

David Brown (D., L. & W.): We get more breaks on the bottom braces of a rod

frame than any other part of the frame, and we generally find the breaks within 5 to 7 in. of the bottom of the pedestal leg. You will probably find them spring open ⅛ in., which indicates that the bottom brace was too short.

H. H. Vaughan (Canadian Pacific): Considerable frame movement is due to twisting, especially on rough tracks. The bottom jaw of the pedestal moves in and out from ⅛ to 3/16 in. with reference to the top of the frames. That is due largely to the side thrust of the leading wheel. If you calculate the amount of opening at the bottom of the jaw necessary to strain the material above the elastic limit, you will find it is a little under 1/10 in. This is what happens largely—the men are careless in handling the engine, and with water in the cylinder it is an easy matter to stretch the binder, and the engine goes over the road with that amount of slack in the binder and causes stretching of the frame over the top bar. As a remedy the clip binder has been applied, and none of the engines with a clip binder has developed that trouble.

E. E. Betts' Car Record System.

Mr. E. E. Betts, of the Chicago & North Western, Chicago, has devised a simple scheme for saving work in copying car numbers into books, and has issued a pamphlet describing his plan. This pamphlet is copyrighted and application has been made for a patent on the plan. The most novel feature of Mr. Betts' arrangement is the form of blank provided for the freight conductor's trip report and for the interchange report.

Initial	
Number	
Contents	
Point of Shipment	
Final Destination	
Taken at	Conductor
Left at	
Car Mileage	Date
Weight of Car and Contents in Tons	
Ton Miles	

Fig. 1—One Square of Conductor's Report.

Initials	
Number	
Point of Shipment	
Final Destination	
Contents	
Delivered to	R. R.
At	
Date	Hour M.

Fig. 2—One Square of Interchange Report.

The conductor's report is a sheet 9 in. wide x 15 in. long, made up of 28 squares, each 2⅛ in. wide x 1¾ in. high. This report serves for 28 cars, each square containing the data for the record of one car. The conductor makes two copies of this report, by the use of a carbon sheet, and the original, being perforated, is torn up into squares. One square of such a report is shown in Fig. 1. The blank has four columns, with seven squares in a column. The heading of the blank shows the usual data—date, hours, termini, mileage, overtime, etc.

The interchange report is in similar form, one square of this being shown in Fig. 2. Fig. 3 shows a complete sheet of the junction.

As every one interested in car accounting knows, there is troublesome and costly "lost motion" in the car-record office in consequence of the great amount of time occupied in flopping the leaves of a large book to find the proper page on which to enter a given car-number; and the separating of each record, by putting it on a card by itself, so as to enable the perfect sorting of the numbers in proper order, provides the rational remedy for this "lost motion." Mr. Betts sets forth the advantages of his plan as follows:

A car record is made from conductors' wheel reports, showing cars handled in their respective trains, agents' interchange reports, showing cars received from and delivered to connecting lines, and junction reports, received from railroads, showing the delivery of a car to any line, except the owner road. On a railroad owning 50,000 cars, and having 15,000 foreign cars on the line, there would be about 30,000 records to enter daily. Each clerk is assigned about 3,000 home cars and 1,200 foreign cars, and will make between 1,200 and 1,500 entries on a local or home record and about one-half as many on a foreign record. In order to make these entries each clerk must look over, say, 1,000 wheel reports, 300 interchange reports and 200 junction reports, 1,500 in all, taking therefrom an average of two cars per report. After locating his car on the report he must then turn to the proper place in his book and make the entry. It is no small problem to keep these 1,500 reports circulating properly so that each clerk will have work all the time. Each clerk must rest his eye on each car number on each report, or 30,000 car numbers daily, which consumes a great deal of time; and after locating his car additional time is consumed in turning to the proper place in the book where the entry is to be made, so that the time consumed in actually writing the record in the book is a small per cent. of the total time consumed in the entire transaction. To do away with this lost motion and permit the record clerk to devote his entire time to the actual writing of the record in the book, this system has been devised.

As soon as the squares are received in the car accounting office they are deposited in

JUNCTION MOVEMENT		JUNCTION MOVEMENT		JUNCTION MOVEMENT		JUNCTION MOVEMENT	
Initials		Initials		Initials		Initials	
Number		Number		Number		Number	
From	R. R.	From	R. R.	From	R. R.	From	R. R.
To	R. R.	To	R. R.	To	R. R.	To	R. R.
Date		Date		Date		Date	

Actual size of blank 9x15 inches. Actual size of squares 2⅛x1¾ inches.

Fig. 3—Junction Record.

a box 4x4x4. A boy then separates the home records from the foreign and private line records, for which two boxes, 3x3x3, are provided. These boxes to be lettered "Home Record" and "Foreign and Private Line Records." The home records will then be separated by the two ending numbers, 100 boxes being provided for this purpose, lettered, "00," "01," "02," "03," "04," and so on, up to and including "99." The foreign records will be separated in accordance with initials, boxes being provided for each road or private car line. After these separations are made the records are then ready for distribution to the clerks in accordance with work assigned. Duplicate boxes are provided for clerks lettered as above, in accordance with the assignment of work.

The leaves of the local record book are 23 in. long x 24 in. wide, 2 rows of car numbers and days of the month on each page, 75 car numbers in each row, 150 to the page, and 300 numbers in sight all the time, without turning a leaf. The book is arranged so that all of the cars with the same ending number are placed consecutively. Take, for instance, cars ending with "00." Car 100 comes first, followed by 200, 300, 400, 500, 600," and so on, to include all cars in the equipment ending with "00." Then follow with cars ending with "02," "04," etc., if the equipment is separated into odd and even numbers. On a road with 30,000 box cars, even numbers, there would be 300 cars with numbers ending with "00." There would be 300 car numbers in the record book visible at all times, so that, when the record clerk gets his work it can be entered without any turning of pages at all.

The foreign records are distributed to clerks in accordance with the accounts assigned them, each clerk having a separate box for each account. It is not necessary to separate these records according to any numbers, as very often the ending numbers appear on one or two pages.

Under this system a local record clerk can care for 10,000 cars, and a foreign record clerk for 5,000 as easily as 2,500 and 1,200, respectively, under the present system. There is, therefore, a saving of over 70 per cent. clerk hire over the present method.

There is no additional work entailed upon conductors in making up the wheel report with the exception of writing the date on each square, and for this a rubber dating stamp should be provided, with conductor's name on it.

The plan will save considerable office space, which often is valuable.

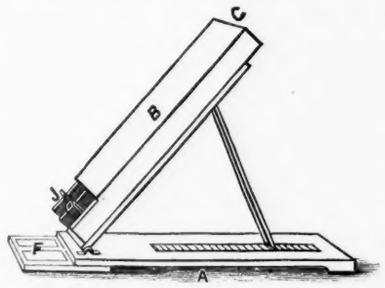
The only offset against the saving made is the cost of extra stationery used, and the wages of the boys to distribute the records. This will vary according to the size of a road; but on a basis of 65,000 cars, home and foreign, a net saving of at least $10,000 per annum can be effected.

On several large railroads the records after receipt in Car Accountant's office are now being transcribed, in order that the work may be distributed direct to the clerks. This is expensive, and productive of error. By using the original reports this expense and liability to error are avoided.

The Tintometer.

The tintometer, devised by J. W. Lovibond, of Salisbury, England, is an instrument by means of which the color of any object, liquid or solid, opaque, translucent or transparent, can be measured and analyzed in such a way as to permit the keeping of a simple and easily understood record; and for facilitating the establishment of color standards and promoting adherence to them. The enumeration below of the uses to which this instrument is put, will suggest various departments of work in which it could profitably be used on a railroad; but it is described here more particularly because it is adapted to testing the colors of signal glasses. A signal engineer having called our attention to the frequency with which colored glasses offered are found to vary in tint from the glasses of the same color already in use or bought from other makers, it seemed proper to call attention to this simple means of establishing standards and of enforcing conformity to them after they are established.

The construction of the tintometer is shown in the illustration. The box B is a rectangular tube black on the inside for cutting off side lights. The tube is divided in the middle lengthwise. In the right-hand side at the lower end is placed the standard glass J, 2 in. x ¾ in., and in the left-hand side the object to be tested. The observer looks into the box at C and sees the standard glass and the glass to be tested side by side and readily notes any difference that may exist; and by successively using standards of different degrees he can measure such difference. The illustration shows in the left side a square glass cup for holding liquid, as, for example, impure water, or oil, or wine. When a very pale liquid is to be tested the instrument is provided with a glass receptacle made very long, so as



to enable the observer to see through a large mass of the liquid. Where necessary, a reflector is placed in front of the lower end of the box. The manufacturers of the tintometer make a series of standard glasses in which the colors are accurately graded from .006 to 20 units. These glasses are of three colors, red, yellow and blue. To make orange, red and yellow are used together; to make green, yellow and blue are used together, and to make violet, blue and red are used. The standard white is pure precipitated limed sulphate, pressed to an even surface. Each of the three colors of a given number has the same color value as either of the other colors of the same number. For example, five units of orange are made by taking five units of red and five of yellow, and looking through both together. By taking equal units of all three colors the light will be entirely absorbed and the result will be black. There are 155 gradations for each color, so that there are 465 different glasses; but for ordinary uses only a small portion of these are needed. A glass with .006 units is so pale that the color is barely recognizable. Experience with these glasses has shown results corresponding to those found by Aubert, who found that a normal eye would detect an admixture of one part of white light in 360 parts of color.

The tintometer is used by dyers of silk, wool and cotton; by painters; by makers of dyes, yarns, and cloth; paper makers and stainers; by steel makers for measuring the color of metals, both cold and when melted, and for estimating the percentage of carbon in steel; also for estimating the percentage of sulphur in steel and iron and in copper ores; by oil refiners and soap makers; by chemists for measuring the turbidity of waters; by bakers for ascertaining the color value of dough; and for many other uses. In testing color-blind persons it affords an accurate means of finding and recording the degree of color perception and of measuring the difference of color vision between two eyes.

The tintometer is sold in America by Eimer & Amend, of 207 Third avenue, New York City, and costs from $21 upward. Standard glasses cost 72 cents each.

Performance of Automatic Signals Under Unfavorable Conditions.*

BY H. S. BALLIET.

V.—BATTERIES (CONTINUED.)

The storage cells in most general use for signals belong to the class known as "lead accumulators." In these cells, strips or plates of lead separated by strips of rubber or suitable insulating material are placed in an electrolyte consisting of sulphuric acid diluted to about 1.17 specific gravity, which density corresponds to about 23 per cent. of acid in the liquid. When charging an accumulator, the passage of current through the cells causes the accumulation of sulphuric acid, which in turn produces a phenomenon known as gassing or boiling, which is an indication that the cells are about charged. In addition to noting this gassing point, it is well to observe the color of the plates, which should be a deep velvety brown for the positive and a slaty gray for the negative. This condition also is a sign that they are properly charged. Not infrequently there is present an insoluble sulphate which forms on the edges of the plates; it resembles a white coating or glaze. This condition should be avoided and if it occurs should be treated by prolonged overcharging and discharging to about 1.8 volts per cell.

It will be noticed as the charge continues that the density of the electrolyte increases; it should in all cases gradually rise from the normal (1.17 specific gravity) to about 1.21 specific gravity, indicating the presence of about 28 per cent. sulphuric acid when the charge is completed.

The e.m.f. of the various cells which have been mentioned is approximately as follows: Gravity, 1 volt; potassium hydrate cells, .7 volt, and sodium cells, .7 volt while that of the accummulator is approximately 2 volts. It is 2.05 when slightly discharged and gradually falls to 1.90 volts when nearly discharged.

The acid must be diluted with pure distilled water and the acid itself be made from sulphur; not from pyrites, as is frequently done. In the maintenance of these cells, great care should be exercised that the acid is properly diluted and that it is free from impurities such as copper, iron, arsenic and nitric and hydrochloric acids, otherwise the plates are apt to be injured.

The experience of the past winter has refuted many claims which have been advanced to discourage the general adoption of accumulators for signal purposes. It has been stated that these cells should be placed in 7-ft. wells, like the gravity battery, on account of their liability to congeal. Readings taken at various times and in widely different localities indicate that the drop in 55 cells was less than one volt for the 110 volts represented, *i. e.*, the nest measured 110 volts before the cold wave set in and during its progress; the decline due to the cold was about one volt, apparently. These records come from points where the discharge rate

*Previous articles on pages 137, 242, 287 and 382; also p. 102, Vol. XXXVII.

averages 5 amperes for 4 seconds. A number of these readings were taken with the thermometer registering 20 deg. F. below zero. A few cases are on record where accumulators are used to deliver approximately .5 ampere continually; these are protected with nothing but a 1-in. hemlock partition, and the temperature is known to have been 10 deg. F. below zero for four days, with no apparent reduction in e.m.f. From these records, it seems justifiable to use these cells within shelters like numbered 5 in my last article. If this conclusion is correct, it indicates the possibility of great improvement in the operation of electric signals during severe winter weather, owing to the higher voltage available.

It has been the general belief that accumulators should be kept in cool places, but experiments carried through two years show that no ill effect results from exposing them directly to the rays of the sun. A curious result of the change in capacity by the application of heat is that by this means we can apparently get more current out of a cell than is put in.

A well known storage battery authority reports as follows: "A cell was charged at 14 deg. C. with 61.9 ampere hours at a rate of .109 amperes per square inch. The cell delivered on discharge after being heated to 45 deg. C. 96 ampere hours. Charged at a rate of .0685 amperes per square inch and temperature of 14 deg. C., 76 ampere hours were put into the cell and it discharged 108.3 ampere hours on being heated to 45 deg. C."

To apply charging current to a number of sets of accumulators through line wires a central station is necessary; or the current can be purchased from some convenient power company. It is not always economical to establish a central station, especially when current can be bought at four cents or less per kilowatt hour and the service is available under all circumstances. When a system of signals extends through many towns and power of suitable potential is available, it is better to charge in small sections, as the use of a number of different sources reduces to a minimum the danger of interruption.

There are in service at this time three distinct methods for operating automatic block signals when accumulators are used: (1) Power-charged cells by line wire, (2) power-charged cells (portable), (3) by employing primary cells. When power lines are installed the wires used in transmitting the charging current to the various sets of batteries are placed on the poles carrying the telegraph and telephone wires, the cost of a separate pole line being thus avoided. These line wires are generally .165 inch in diameter, being hard drawn copper with either double or triple braid weatherproof insulation and each wire weighing between 520 and 600 lbs. per mile. In case of sleet or high wind storms, these wires are subjected to many chances of interruption and unless the system is designed to work in spite of occasional breakdowns of the pole line, there is likely to be unnecessary detention to trains owing to the accumulators becoming exhausted. Cases are on record where pole lines have been washed away by floods so that they could not be restored for a week. In cases like this, it may become necessary to put in primary cells temporarily. Such a condition has repeated itself in certain sections of the country for two seasons, and without the aid of primary cells the automatic block signals would have been out of order at least 12 hours after traffic was resumed; but by the use of primary cells trains were run by the signals (track-circuit) while there was still one or two feet of water covering the track.

According to the report of a committee of the Railway Signal Association, power lines are only applicable where three, four or more parallel tracks are signaled, the blocks being approximately one mile in length. Figures quoted by this committee and data supplied by those operating such a system show great economy as compared with a primary cell installation. As a rule, on a four track road six cells (approximately 12 volts) in series are installed, thus making it possible to operate four signals from one battery if necessary. Also at terminal stations or yards and in special outlying cases where many signals are required in order to move a large number of trains close together, the total number of cells to operate them can be reduced, thereby effecting a saving as compared with primary cells. Where conditions are favorable, accumulators are used for track circuits. Where conditions warrant the use of power line and accumulators the decrease in the labor charge is very perceptible.

When portable accumulators are used, it is customary to install four cells (approximately 8 volts) at each signal. These cells should be of sufficient capacity to furnish current for at least one month. At the expiration of this period, the cells are removed and taken to a designated central station where they are charged. If signals are 1½ miles apart and only one or two tracks are signaled, the portable accumulator system is preferable.

Under such a system all cells can have a regular inspection and the life of the plates can be much extended by having expert attention. The rapid increase of the "all-electric" power-operated interlocking plants has made portable batteries popular because there is no need of installing special central stations. These all-electric plants are being rapidly introduced at isolated places on many railroads, so that the question of distributing cells every 30 days becomes an easy problem. By supplying a full set of 55 or 56 cells of accumulators, they can be charged in multiple with the regular quota of cells used for the interlocking plant, with no additional expense for fuel or attendance. These cells are always available for renewal of those which are exhausted. The cost of transportation of the cells is practically nil, when a regular routine of renewals is established. Work trains on congested parts of the road and tricycle speeder cars on less busy sections can be used for this purpose. On a large road the maintenance force can often be reduced as much as 40 per cent; *i. e.*, a road employing a signal repairman and a batteryman for every 15 miles of double track can reduce the force in almost every case so as to require only one batteryman for every 30 miles. Such a system has advantages over the line wire system because there is no pole line to interrupt the regular charging; neither are crossed overhead circuits causing short circuits or grounds. In case of serious floods or other interruptions it is probably less annoying and there is less delay in getting signals in working orders.

When accumulators are charged by primary cells, it is customary to use the gravity cell, four being required for each accumulator. Such records as are available indicate that the cost of maintenance on such a system is less than with primary cells used direct and more than by either the portable or the line wire charging systems.

Objections to such a system are (1) the fact that the gravity battery needs frequent renewing, (2) liability of broken jars in the charging battery and (3) possibility of freezing of the charging battery, unless extraordinary measures are taken, as mentioned in the beginning of this article. There is one advantage gained by such a system as compared with a primary cell system, and that is the increased amount of current available at all times. In a system of electric semaphore signals, this is very necessary where weather conditions are variable.

The question is frequently asked as to the advantage of having the battery or power localized at each signal, as compared with the systems using a common source of current or power. The subject should be considered in two distinct parts: First, signals worked by battery; second, those worked by power. When battery is employed and the current for each block is localized (whether it be at the signal it operates or at the next signal in advance with the signal-operating current transmitted by line wire) the delay to trains is reduced to a minimum, because an exhausted battery, a broken cell or a broken line wire interrupts but one signal. When a common battery is used for several signals, all of them are interrupted.

When air is used a broken main pipe or a shut-down at the pumping station affects all the signals dependent on that pump or that pipe. When compressed air in reservoirs or liquid carbonic or dioxide gas is used, with a supply at each signal, the delay or interruption is limited to one signal.

High winds in summer and sleet or snow in winter are responsible for many broken line wires and not a few detentions to trains are charged to this cause under the battery system. Floods have caused the stoppage of many trains and under a common battery system would cause no end of complaint from the transportation department, whereas if each signal has its own battery, the failures are reduced to a minimum and in many cases the signals are in perfect working order long before the track is ready for service.

During the past winter many main air pipes were pulled apart on account of contraction; and not a few cases are recorded where many miles of signals were out of order for hours from this cause. What little damage is incurred by high water when air or gas is provided in cylinders at each signal is inconsiderable, and the detention to trains is even less than in the battery system.

Master Mechanics' Reports.

Last week we printed a number of reports and papers presented to the Master Mechanics' Association. Others will be found below:

COAL CONSUMPTION OF LOCOMOTIVES.

One of the most thorough and comprehensive reports presented was that of the committee appointed to consider the above subject. The report is subdivided under four general heads as follows:

1. Is the operation of large engines what it should be from a standpoint of engineers and firemen?

2. Are the present tendencies as to large grates and heating surfaces disadvantageous? Are the proportions correct?

3. Is the large locomotive giving results in operation which would be expected from the large increase in capacity?

4. Is the operating department of railroads deriving the amount of assistance and relief from large locomotives which may be justly expected? If not, how should the attention of the locomotive designers be directed?

Operation of Locomotives from Standpoint of Engineers and Firemen.

Theoretically, the pooling of locomotives is advantageous, but there are many conditions which detract from the theoretical benefit of such method of handling, when applied in practice. It may happen that en-

gines pooled at different terminals will run over not only one division, but a number of divisions and come in contact with various conditions affecting their economical operation, and the interest manifested by the men who operate the engines and those who care for them at terminals is diminished, resulting in a decreased efficiency in their performance. The pooling system has a demoralizing effect on the interest which is taken in the maintenance of the engines and their operation by the enginemen and firemen, resulting ultimately in less loyalty to the company which they serve. However, in numerous instances pooling is necessary, and where such is the case it cannot reasonably be expected that motive power can be maintained with as little expense as can be done with regularly assigned engines. The attention to detail of maintenance in keeping the motive power in serviceable condition without continual shop repairs is the keynote to good operation and economy, and is more likely to be obtained under a regular assignment where each man runs one

TABLE I.

Engine.			Cylinder.		Wheel.	Fire-Box.		Flues.			Weight in Working Order.			Boiler Press.	Heating Surface.			
Letter.	No.	Type.	Diam.	Stroke.	Diam.	Lgth.	Width.	Number.	Diam.	Length.	Drivers.	Truck.	Total.	Lbs. per Sq. In.	Fire-Box.	Flues.	Total.	Grate Area.
A	606	Mogul Comp.	15½ / 26	28	62	100¾	71¼	350	2	13- 4	135,000	29,000	164,000	200	183	2,443	2,626	48.5
B	1,051	Prairie Comp.	17 / 28	28	69	108	71¼	318	2¼	18-11	141,690 / 156,190	68,500 / 54,300	210,190	220	195	3,543	3,738	53.5
C	601	Mogul Simple.	20	28	62	100¾	71¼	350	2	13- 4	132,000	25,100	157,100	200	183	2,443	2,626	48.5
D	565	Prairie Comp.	16 / 28	28	63	102⅛	72¼	318	2¼	18- 4⅞	134,500	76,500	211,000	210	219	3,447	3,666	51.25
E	175	10-Wheel Simp.	18	24	63	77⅛	33⅝	196	2	13- 9½	88,400	34,500	122,900	180	145	1,415	1,560	17.9
F	839	Consol. Simp.	21	30	56	112½	41¾	263	2¼	14- 6	147,300	18,200	165,500	200	182	2,233	2,415	32.6
G	923	Consol. Simp.	21	30	56	112½	64¼	273	2¼	14- 6	157,850	17,250	175,100	200	156	2,318	2,474	47.3
H	861	Consol. Simp.	21	30	56	112½	41¾	263	2¼	14- 6	147,300	18,200	165,500	200	182	2,233	2,415	32.6

particular engine than where one man runs forty engines. With a regular assignment each engineman becomes not only an inspector but an educator for the particular fireman who may be assigned to him and a certain pride attaches to both men to maintain and have maintained that part of the property of the company which is entrusted to their care.

Nearly every railroad follows the general rule of obtaining enginemen by promoting firemen who have passed through a reasonable course of training in road service prior to their promotion. This being so, the importance of employing proper material for firemen is apparent. The primary requisites in employing firemen are, a fair general education, the importance of fuel consumption, the best methods of firing to result in fuel economy and the operation of the locomotive to prevent fluctuations in temperature which are detrimental to the boiler and consequently efficient operation. Satisfactory evidence should be given by firemen applying for a position of their knowledge and ability to handle fuel, prior to the approval of their application. Railroads have had to employ men on short notice and have consequently taken the material which has offered. If, however, it were well established as a general rule that each railroad required certain qualifications to be fulfilled before employment would be given, vacancies could be filled with material of a higher order, as the inducements offered are superior to those of most trades consistent with the requirements from the applicant.

The result of pooling engines is further shown by the inability of firemen to cope with the differences in designs of engines as well as can be done when they are regularly assigned to one engine, especially where conditions warrant the use of both wide and narrow fire-box engines. The care with which wide fire-box engines should be fired is not generally appreciated by the men. This is perhaps largely the cause of the numerous troubles due to leaking which are experienced with this type of engine. It is much easier to maintain an even fire on a small grate than a large one and the tendency with the large grate to allow different temperatures at different parts of the fire is considerably more than obtains with the small grate, hence the necessity of additional care on the part of the men operating an engine with a wide fire-box and relatively large grate area.

The Relative Merits of Large Grates and Heating Surfaces and Their Proportions.

The tendency in locomotive design recently has been to the broad fire-box, giving a relatively large great area and tube heating surface, while the fire-box heating surface has not been increased in proportion to these. For purposes of comparison the committee selected eight locomotives of different types of the dimensions shown in Table I. Data of tests from these engines was available and comparisons were based on these tests:

Engines A, B, C, D and G are examples of the tendency to increase the grate area by broadening the fire-box and may be considered modern engines of this type of construction. Of these engines A and B are Vauclain four-cylinder compounds, D a tandem compound and C and G simple engines.

The tests which were made were carried out under road conditions to determine the relative efficiencies of engines of the types A, B, C and D, as compared with the opposite extreme of type, E. Under similar conditions engines of type E have a high rate of combustion, as compared with types A, B, C and D. There is a high fire-box temperature with less air of dilution but sufficient air admitted through the grates to allow reasonably complete combustion. With the high duty of the fire-box heating surface, as compared with flue-heating surface, the former absorbs a large proportion of the heat of the high temperature fire-box gases which is further diminished in temperature by the heat absorbed in the flue-heating surface, so that, although the smoke-box temperature is probably higher than that in the boiler with a lower rate of combustion, and the passage of the gases from the fire-box to the smoke-box also being freer on account of the ratio of the grate area to the flue area, a rapid transfer of heat through the sheets of the fire-box and tubes results in a very high duty of the heating surface. The efficiency depends principally on the difference of temperature between the fire-box and smoke-box gases, so that this boiler would indicate a design which is well adapted to be forced to high duty with relatively good economy.

Comparing type B, the extreme example of wide fire-box construction with moderate forms indicated by types A, C and D, it will be seen that

1. The ratio of heating surface to grate area is large, compared with engines A and C.

2. The ratio of tube-heating surface to fire-box-heating surface is large.

3. The ratio of grate area to tube area is but slightly larger than that in the other wide fire-box engines.

This boiler gave the most efficient performance, due probably to the relatively large heating surface in proportion to the fuel consumed and the slow rate of combustion, while the duty of the heating surface was relatively low.

It would appear generally that as the rate of combustion is increased the circulation of the fire-box gases is heightened, and if a corresponding increase in the circulation of the water in the boiler results from the increased circulation of fire-box gases, which may generally be expected, there would be but a small decrease in the efficiency of the boiler itself. It is to be remembered, however, that in obtaining forced combustion in locomotive practice it is necessary to diminish the power of the locomotive and hence affect the efficiency of the machine as a whole, for the reason that such forced combustion is obtained by means of an increased back pressure in the cylinders resulting in a corresponding loss in effective work. The design of the boiler for the locomotive is primarily fixed by the allowable limits of the weight of a certain type of engine, and in a general way it should be remembered in choosing a high rate of combustion that such forced combustion affects both boiler efficiency and engine efficiency.

Within reasonable limits, however, the economy of the boiler and the engine may not be expected to vary widely if the proper proportion of grate area to heating surface, fire-box heating surface to flue heating surface, and flue area to grate area are maintained.

The latter proportion in a general way has some effect on the circulation of the gases, as is indicated by the fact that in large boilers with a large number of flues some of them may become stopped up, resulting in but little depreciation in the steaming capacity, whereas, in the small boiler, such as the E engine, if the flues are not kept clean the steaming capacity is materially interfered with; probably also on account of diminishing the heating surface.

Wide fire-box boilers of practically the same capacity of narrow fire-box boilers give more trouble in actual service from leaking. This is probably due to the wide fire-box being more difficult to fire and to keep covered with a uniform thickness and temperature of fuel, resulting in fluctuations of temperature in the fire-box which affects sheets by alternate expansion and contraction, resulting in more or less leakage and deterioration of the boiler itself.

If it were possible to obtain the same efficiency in the boiler with a small grate by increasing the rate of combustion within reasonable limits, this disadvantage of the wide fire-box engine might be overcome to some extent, but improvement in this direction is more to be looked for by the education of

the fireman than by a change of design, which results in less efficiency for the locomotive as a whole.

The efficiency of wide fire-box boilers in ordinary operation in road service should not be based on the actual amount of coal consumed while they are hauling a train, but rather on the basis of the total coal consumed, including the coal used at delays in firing up and at terminals.

TABLE II.

Engine number.	Total coal used running.	Total coal used at delays.	Average time of delays. (hrs. min.)	Total coal used to fire up.	Average time to fire up. (hrs. min.)	Per cent. of coal used to fire up and at delays to total amt.
*606	14,106	1,037	2—17	1,410	5— 6	14.8
*601	18,198	1,167	3—38	1,555	4—13	13.0
*1,051	14,822	863	1—54	1,662	6—16	14.5
565	15,815	1,155	3—15	....	....	...
*175	12,366	598	2—35	....	....	...
‡923	16,041	1,234	5—58	1,200	....	13.2
‡839	81,797	765	3—55	1,250	4—40	9.7

*Average of 5 trips.
‡Average of 12 trips.

In this respect Table 2 indicates for the engines tested the relative amount of coal consumed by these delays and at terminals. In a general way it will be seen that the narrow fire-box engine has an advantage in economy for standby losses and in firing up, so that in considering the ultimate worth of the two designs, remembering that within reasonable limits of rates of combustion the maximum consumption is 120 lbs. of coal per square foot of grate per hour, the performance of the boilers does not vary considerably, the ultimate performance being based on the total amount of coal used to determine the relative merits of the two designs when compared in actual road service.

Results Given in Operation by Large Locomotives.

The usual method for comparison of the performance of engines is generally stated as the cost of repairs per engine mile or per ton mile, usually the former, while the fuel consumed is more generally based on the latter. As these statements do not present a definite value, since they do not take into account all the important conditions which affect the performance, it is probable that such comparison would be more accurate if based on the approximate power which the locomotives develop in service.

A comparison of the relative increase of number and size of locomotives, cost of fuel and repairs by years from 1897 to 1903, inclusive, for a comparatively mountainous road shows that from a fuel standpoint while the total tractive force in seven years increased 79.1 per cent., the average tractive power per engine has increased 30.7 per cent., the freight ton mileage has increased 86.7 per cent., and the freight ton mileage per engine 35.2 per cent., whereas, the total coal used by engines increased 79 per cent., which, based on the pounds of coal per 1,000 ton miles, decreased 4 per cent., showing that the increase in the size of power was in this instance accompanied by a decrease in fuel consumption on a ton mile basis. This was accompanied by a decrease in the cost of engine repairs on a ton mile basis, with a slight increase on an engine mile basis.

A more striking instance of the saving due to the installation of heavy power is shown in the case of a comparatively level road. On a basis of fuel consumption, with an average increase in tractive force per engine of 95.77 per cent. in 1903 over 1897, the freight ton miles per pound of tractive force decreased but 5.76 per cent., the total coal used by locomotives increased but 78 per cent. and the pounds of coal per 1,000 ton miles decreased 3.75 per cent.

Aside, therefore, from the saving in train and engine crew wages by the installation of heavy power, it seems probable from the statistics of these two railroads (which are representative) that not only is a saving in expenses to be looked for by the installation of the heavy power, but that an actual saving in the cost of repairs and fuel will also result when based on the power developed by the locomotive.

Considering compound engines, as compared with simple engines, the modern compounds, types A, B and D, showed much better efficiencies than the simple engine, C, in the tests that were made. An increased economy in steam in the cylinders of the engine will require a less demand for steam for a given power on the boiler, resulting in increased economy for the compound engines by increased efficiency of the boiler, giving a combined efficiency for the two, and, therefore, a higher average performance of the locomotive as a whole. It is probable that some proportion of the economy of the compound engine is due to a less back pressure in the cylinders to maintain a sufficient draft on the boiler to supply the requisite amount of steam, so that generally the higher the draft required the less efficient the boiler and less efficient also the engine. This, in a measure, also affected the showing made by the wide fire-box engines. The wide fire-box engine requires a milder draft, giving, as shown by the boiler tests, a higher boiler efficiency and resulting also in diminishing the back pressure in the cylinders, the combined effect of which would give a high efficiency.

The cost of repairs to fire-boxes of the wide and narrow type on engines of the same size is a matter on which the committee has not secured definite information. The prevailing opinion seems to be that the cost of repairs in the roundhouse for wide fire-box engines is more than for the narrow and the shop cost about equal for wide and narrow fire-boxes, principally on account of flues. The expense for heavy engines is greater than for light engines, but the tons hauled is a larger percentage with less engine miles, one road reporting the figures as follows: The total engine expense for consolidation engines was 32 per cent. greater than for ten-wheel engines on the same district, the tons handled was 50 per cent. more and the miles run 22 per cent. less. This on a division where the ten-wheel engine is a strong favorite. The tractive power of these consolidation engines is 80 per cent. more than the ten-wheel engines and their general average will run 65 per cent. more tons per mile.

The Large Locomotive as an Aid to the Operating Department and Its Relative Advantages in Operation.

The large capacity locomotives lose their efficiency unless they can be loaded to their maximum capacity. The difficulties in governing traffic are not entirely in the hands of the operating officers, which results in some instances in using heavy engines on comparatively light trains. Generally the assignment to any district is proportional in a measure to the capacity of the engines, so that with large engines and a variable traffic, the expected efficiency will not be attained. Under these conditions probably light engines will suit better.

Large engines with a comparatively heavy train cannot go into side tracks as rapidly as small engines with short trains without damage to equipment nor run for meeting points with as much assurance of making them, resulting in more serious delays along the road, yet, from the fact that the large engines are hauling more cars and tons with fewer miles run for the same total cost per engine, including the interest on the large investments, it appears that where traffic conditions warrant heavy power, it is both economical from a fuel, repair and operating standpoint. It must be remembered that with heavy engines a given amount of tonnage may be moved with fewer trains, resulting in fewer meeting points to be made and consequently fewer chances for delays in this respect.

As the capacity of the locomotive has increased, its usefulness as a unit increases proportionately, so that any defects which exist on the road become more serious with heavy power than with light power. The utmost care in design, to prevent breakdowns on the road, should be exercised when building locomotives, and their proper care and maintenance when in road service is essential to good operation.

With the increased capacity of locomotives sufficient care has not been given to road maintenance and the prevention of failures on the road. With the growing demand from year to year for power, not only has the pressure brought to bear on the builders required them to furnish engines as expeditiously as possible, but proper arrangements have not been made to maintain such engines when they have been put into service.

Conclusions.

The increase in efficiency of enginemen and firemen in road service depends largely on the employment of suitable material to fill the position of fireman. For numerous reasons, proper consideration has not been given to this matter in the past few years and has led to diminished efficiency in coal consumption, influenced also by the method generally followed of pooling the engines without proper facilities to maintain them in such handling.

The relatively large boiler results in economy, not only in itself, but also economy in the engine, so that it is desirable to have as large a boiler as the limitations imposed by the engineering department will warrant for any particular design of locomotive.

The grate area of the locomotive boiler should be limited to a certain rate of combustion per square foot of grate. Small decrease in efficiency in boilers is obtained by increasing the rate of combustion within a maximum limit of 120 lbs. of coal per sq. ft. of gate per hr., yet due to the fact that with a slow rate of combustion a milder draft will serve. The large grate with a slow rate of combustion has an advantage in increasing the efficiency of the engines.

The loss of fuel at delays is probably greater as the area of the grate increases. This is in a measure offset by the fact that large grates are found on large engines. With the large engines fewer trains are required to move a given tonnage and consequently delays are diminished. This would have a tendency to counterbalance the increased fuel consumption due to increased grate area. There should be a design of grate of sufficient area to compromise between the loss due to delays and at terminals from the large grate and the loss in effi-

ciency while running due to the small grate.

The introduction of designs of locomotives with a large proportion of the weight on trucks and trailers has resulted in efficient performance as regards fuel economy for both boiler and engines. Generally with this design the capacity of the boiler is relatively increased in proportion to the available power developed by the cylinder (which is limited by the weight on drivers) and consequently such designs are best adapted to give efficient performance where a relatively high horse-power is to be maintained for a comparatively long time, such as, for instance, in passenger service or in through freight service.

The relative worth of a large unit of power to a small unit warrants the maintenance of large engines to a higher standard than small engines and to accomplish this proper facilities should be provided.

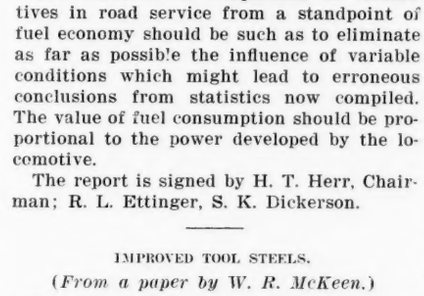
The methods of comparison of locomotives in road service from a standpoint of fuel economy should be such as to eliminate as far as possible the influence of variable conditions which might lead to erroneous conclusions from statistics now compiled. The value of fuel consumption should be proportional to the power developed by the locomotive.

The report is signed by H. T. Herr, Chairman; R. L. Ettinger, S. K. Dickerson.

IMPROVED TOOL STEELS.

(From a paper by W. R. McKeen.)

The following tests of tool steels were not made on specially devised castings or forgings, nor were any machines arranged in special reference to these tests. All observations were made on work going through the shop during regular working hours and on actual locomotive parts being put through the shop; these same parts being afterward applied to locomotives. The tests were conducted according to the directions of the chemist and engineer of tests, and under the supervision of the general shop demonstrator; the electrical readings were taken by the local electrician, and the machines were handled in their regular course by the mechanics assigned to each class of work. Turning and planing tools were forged and tempered by the regular toolsmith, and the twist drill and milling cutters were made in the local toolroom. Under these conditions a much fairer comparison as to the actual benefits obtained from alloy tool steel in regular shop practice can be made than where special test conditions are followed.



Carbon Steel. *Alloy Steel.*

Tools Used on Cast Iron.

Three lines of comparison were taken, namely: First, the speed, cut and feed; second, the durability of the tools; third, the amount of power expended in keeping a tool up to its proper capacity. The first depends upon the volume of output; the second on the quality of steel and manufacturer's and toolmaker's skill; the third being closely related to the first and dependent on it.

A summary of the tests follows:

Planer Tests.—Alloy steel necessitated 20.9 horse-power removing 780 lbs. of metal per hr., as against 15.9 horse-power with carbon steel and only 288 lbs. metal removed per hour.

Wheel Lathe Tests.—Alloy steel necessitated 6.4 horse-power with 96 lbs. metal removed, as against 2.3 horse-power with carbon steel and 15 lbs. metal removed.

Lathe Tests (Cylinder Bushing).—Alloy steel necessitated 11.6 horse-power and 180 lbs. of metal removed, as against 10 horse-power with carbon steel and 54 lbs. metal removed.

Milling Machine Tests (Locomotive Shoe).—Alloy steel necessitated 4.4 horse-power and 195 lbs. metal removed, as against 3.1 horse power with carbon steel and 82 lbs. metal removed.

Radial Drill Tests (Cast Iron Blocks).—Alloy steel necessitated 5.6 horse-power and 88 lbs. metal removed, as against 2.6 horse-power with carbon steel and 51 lbs. metal removed.

Improved, or alloy, tool steel has increased the output of railroad shop machines from 25 per cent. to 100 per cent., and in certain cases as much as 200 per cent., and while, with increased output, the horse-power required to turn out work has increased, this increase of horse-power absorbed is not in proportion to the increase in output. The use of alloy steel, where machines have been driven by motors already worked up to capacity, will necessitate 25 per cent. to 50 per cent. larger motors, as has been evidenced by our own experience.

The strength and capacity of our present machines are almost universally overtaxed, for the reason that they were not designed for the new conditions. Our experience has shown conclusively the necessity for heavier and more substantial design of all machines; steel pinions instead of cast iron; longer bearings for shafts and increased diameter. Furthermore, it clearly demonstrates the economy of scrapping old-style machinery.

Our best record on locomotive driving wheels is a 56-in. pair in 1 hr. and 27 mins. Steel-tired car wheels formerly required from 5 hours up to turn and true to size; the present minimum time in our shops is 55 minutes, the average being about two hours. While these reductions in time are largely due to the alloy steel, improved shop methods and system have also entered largely into the economies mentioned.

COMPARATIVE PERFORMANCE OF ALLOY AND CARBON STEEL.

	Machine and Equipment. *Metal Machined.*	Feed per Revolution. (Inches.)	Depth of Cut. (Inches.)	Speed. (Ft. per min.)	*Power to Run Machine.* Light. Volt.	Light. Amp.	Under Load. H. P.	Under Load. Volt.	Under Load. Amp.	Under Load. H. P.	Effective H. P. for Cutting.	Metal. Removed. (Lbs.) Per Hour.	*Tool.* Size. Height-Width. (Inches.)	Angle. Top.	Angle. Front.	Angle. Side.	Kind of Steel.	Total Longitudinal Feed. (Inches.)	Time of Test. (Minutes.)	Condition of Tool after Test.	Remarks.
1	Planer, 60"x60"x30'.....Soft steel side rods	¼	1	16	219	43.8	12.9	219.4	71.1	20.9	8	780	2½x1½	60°	80°	80°	Alloy	4	4⅝	Very good.	Limit of machine.
2	20-h.p. Westinghouse motor... 4' 8" long cut.	3-16	½	16	219	43.8	12.9	212	56	15.9	3	288	2½x1½	60°	80°	80°	Carbon	¾	¾	Burnt. ½"	
3	Wheel lathe, 100" swing.....Old and badly	3-16	5-16	23	228	12	3.7	226	21.2	6.4	2.7	96	2½x1½	82°	78°	88°	Alloy	4	17	Very good.	
4	worn Standard	3-32	3-16	6	226	6	1.8	228	7.6	2.3	.5	22	15	30	2 x1	82°	78°	88°	Carbon	⅞	27½	Burnt up.	
5	15-h.p. Westinghouse motor.. driving wheel	¼	5-16	22	227	25	7.6	228	38	11.6	4	34	180	45	2 x1	60°	80°	80°	Alloy	6	8	Good.	
6	Gear driven.	3-16	5-16	11	228	24.5	7.4	228	32.6	10	2.6	26	54	20.7	2 x1	60°	80°	80°	Carbon	4	14	Burnt up.	
7	Pond engine lathe, 42".....Hard cast iron	.00674	.....	45	222	6	1.8	222	15	4.4	2.6	59	195	75	1⅝" dia.x3½" face	...	...	...	Alloy	20	6	Very good.	
8	tires, 70" dia.	.00275	.....	45	222	6	1.8	219	10.7	3.1	1.3	42	82	63	4½" dia.x3½" face	...	...	...	Carbon	20	14½	Burnt.	
9	Vertical milling machine....Cast iron locomotive	.012	Mean 23-64	100	230	4.5	1.4	228.6	16.6	5.6	4.2	75	88	21	1 7-16" dia.	...	...	...	Alloy	20	1.50 sec.	Very good.	Limit of machine.
10	10-h.p. Westinghouse motor... shoe,	.007	Mean 23-64	64	230	4.5	1.2	228.3	8.5	2.6	1.4	54	51	36.4	1 7-16" dia.	...	...	...	Carbon	6	2.55 sec.	Burnt.	
11	Radial drill.....Medium hard	.012	Mean 23-64	100	230	4.5	1.4	222.9	16.1	4.7	3.3	70	88	26.7	1 7-16" dia.	...	...	...	Alloy	6	6	Very good.	Limit of machine.
12	3-h.p. Vertical Westinghouse cast iron blocks, 5"	.007	Mean 23-64	64	230	4	1.2	227	10.9	3.3	2.1	63	51	24.3	1 7-16" dia.	...	...	...	Carbon	2	14½	Burnt ½"	
	motor.....deep hole.																				
	Radial drill.....Soft steel cutter																				
	3-h.p. Vertical Westinghouse blanks, 4" deep																				
	motor.....hole.																				

TECHNICAL SCHOOL GRADUATES.

(From a paper by R. D. Smith.)

The majority of the problems which confront the civil engineer in his work on the railroad are engineering problems. Most of the problems which confront the mechanical officer are not straight engineering, but are rather combined engineering and business. On this account, while the technically educated man may be familiar with the principles of the construction of locomotives and cars, yet there are a great many things which require something more than an engineering knowledge in order to handle them successfully. This led to the introduction of what is called the special apprentice.

The object of the special apprentice course is to make the man a specialist in railroad work. The indications are, however, that we have not gone far enough. His instruction has covered the whole mechanical field and at the end of his apprenticeship we have not the specialist we desire. Have we not been trying to do too much when we try to familiarize the man with half a dozen or

more trades, the operation of car and locomotive shops and of engines on the road in four years' time? Better results would be obtained by not trying to do so much, but doing what was done more thoroughly, so that at the end of the four years the man would be a specialist. This could be done by offering different courses, each covering a separate field. These courses should be arranged to cover the following work:

(1) Car building and repairs: The four years' work could be divided as follows: Six months in the freight car shop on truck and body work; six months in the passenger car shop; four months in the paint shop; four months in the wood mill; four months in the car blacksmith shop; six months in the car machine shop; four months in the yard; four months in the drawing room; four months in the test room and the last six months at large. (2) Locomotive building and repairs: The four years' work could be divided as follows: Ten months in the machine shop; six months on the floor; nine months in the boiler shop; nine months in the blacksmith shop; four months in the drawing room; four months in the test room, and the last six months at large. (3) Locomotive operation: The four years' work could be divided as follows: Three months in the roundhouse as helper; two months in truck gang; one year as fireman; three months as boiler washer; six months with boilermaker; eight months with machinist; four months in drawing-room; four months in test room, and six months at large. The last six months of each course could be devoted to such work as the master mechanic saw fit.

The special apprentice system is, at best, a poor one. The technical graduate is put in the shop and is given the best of opportunities to learn. He is given a great deal more attention than the ordinary apprentice. He is favored, and what is worse he expects it. On this account in a great many cases we turn out men who would have been a great deal better off if they had been given to understand that their advancement depended entirely on their own exertions. We favor them and turn out a hothouse plant which, when finally transplanted, cannot stand the cold blast of competition. At the same time that the special apprentice is being favored, the general effect on the shop is not good. When the other men in the shop see the technical graduate rushed ahead they are not liable to be nearly so energetic as when they see that all men are being treated alike. The more you take away from a man his prospect for promotion, the less valuable he becomes. If every man in the service feels that his chance for promotion is as good as that of any one else you will have an organization which will do business and be free from discord.

In the February number of the *American Engineer and Railroad Journal* is a description of a plan by means of which the London & South-Western Railway hopes to obtain technically educated men from among its apprentices.

But the railroads are feeling the need of technical men, and the question is how to get them and keep them. If it is possible to hire these men without offering them any special inducement or making any promises I believe it would be the best way. This can frequently be done where a man is wanted for special work. He should be paid what he is worth, the same as any other man. By doing this the apprentices and journeymen's ambitions are not stifled, and at the same time the technical man is put on his mettle, because any advancement which he receives will be due solely to his own efforts.

BEST PRACTICE FOR PAINTING LOCOMOTIVES AND TENDERS.

(Submitted by the Master Car and Locomotive Painters' Association.)

A dipping tank containing a solution of caustic soda, or potash, heated by a system of steam pipes, is of value in removing paint and grease from dismantled parts, such as drivers, dome castings, dome covers, front ends, steam chest casings and covers, number plates, grab irons, etc. The tank should be sufficiently large to hold the detached parts and admit of submersion. It should be placed underground conveniently near a hoisting crane. Where shops are provided for painting of tanks, stationary scaffolds are a convenience. All shops should be equipped with mixing benches and facilities for the proper care of tools and materials, and wherever the force warrants a stockroom with a custodian in charge is economical.

As passenger locomotives run with passenger cars, they should be finished in all respects equal to the cars. Freight locomotives should be painted mainly for durability. Castings and woodwork, on which a good surface is desired, should be made as smooth as possible before the application of paint. Locomotives should not be painted in roundhouses. For painting new parts the following is good practice:

First day, sand-blast and apply the priming coat of paint; second day, drying; third day, second coat; fourth day, putty and fill rough places with knifing surfacer; fifth day, first coat of rough stuff; sixth day, second coat of rough stuff; seventh day, guide coat and rub; eighth day, two coats of color; ninth day, stripe and letter; tenth day, varnish with finishing varnish; eleventh day, drying; twelfth day, varnish with finishing varnish.

For repainting locomotives undergoing repairs the following schedule is good: First day, prepare and apply priming coat where necessary; second day, putty and knifing surfacer; third day, color; fourth day, stripe and letter; fifth day, finishing varnish; sixth day, finishing varnish. On account of the difference in the condition of the paint and varnish on locomotives when they are returned to the shops for repairs, much should be left to the judgment of the foreman painter as to what operations can be added or omitted in order to expedite the work without detriment to its durability and appearance. The following labor-saving appliances and facilities are recommended: The sand blast; the material-saving paint sprayer; the potash vat; the stationary scaffold; suitable mixing benches; paint stockroom (where conditions warrant it).

The report is signed by A. P. Dane, Chairman; B. E. Miller, J. D. Wright, W. O. Quest, E. T. Congdon.

TON-MILE CREDIT FOR SWITCH ENGINES.

It is a comparatively simple matter to determine with reasonable accuracy the ton-mileage made by locomotives in freight and passenger service, but it is practically impossible to do this for engines in switching service. For this reason roads which base the statistics of their locomotives in road service on the ton-mile have not done this for their switch engines. It would, of course, be a simple matter to credit an arbitrary ton-mileage, in the same way that an arbitrary credit of miles per hour is now made, but this would have no advantage over the arbitrary credit of mileage, except that the statistics for all classes of locomotives would be on the same basis.

The best basis for railroad operating statistics is that which most closely measures the work done. The almost universal basis for switch engines is a credit of six miles an hour. It would require but little investigation to demonstrate that this credit does not even approximate the work done, and is far from ideal.

In the proceedings of the American Railway Master Mechanics' Association for June, 1903, is a report of a committee on ton-mile statistics, which gives the results of a series of tests made for the *Railroad Gazette* by Mr. George L. Fowler, a member of the committee, to determine the average mileage of switch engines. The tests were made on nine engines, five in freight service and four in passenger service; the average mileages for the different engines check reasonably close and there is no reason to doubt they are practically correct. The results show less than three miles an hour, the mileage of the engines in passenger service averaging somewhat higher than those in freight service. In the same report is given the result of a similar test made by Mr. E. T. White, Superintendent of Motive Power of the Baltimore & Ohio, a few years previously, which shows an average of 3.75 miles an hour. It, therefore, seems evident that our present arbitrary credit of six miles an hour for switch engines is far from representing the facts in the case, and, therefore, can not be even an approximate measure of the work done.

Even though the present credit of six miles an hour should be changed to three miles an hour, so as to more closely agree with the determined facts in the case, the result would be that an engine having a 10-in. x 20-in. cylinder would be credited with having done the same amount of work as one having cylinders 20 in. x 26 in., which evidently is not reasonable. It is also evident that, so long as the present credit of six miles an hour is given to all switch engines, or so long as the same credit is given all switch engines, regardless of their power or the work done, the resulting statistics will show that the larger the engine and the more work it does, the more expensive is fuel, oil and repairs, and the only practical advantage to be derived from keeping such statistics will be in comparing switch engines of the same weight and power. It is altogether likely that frequently an injustice is done a master mechanic responsible for the records of heavy switch engines when his records are compared with those of another man having a larger proportion of light engines in switching service, as it is evident that, provided each group of engines is in service the same number of hours, which is likely, the credit of work done, expressed in miles per hour, will be the same for all engines, though the larger engines may do twice the amount of work the smaller engines do and require twice the amount of fuel, oil and repairs.

If the actual number of ton-miles per hour could be accurately or even approximately determined, it is evident the unfairness and injustice of the present credit would be remedied, but so far no one has been able to develop a practical method of doing this. However, a unit has been proposed which, while by no means all that could be desired, we believe will result in a credit fairly approximating the facts and proportional to the work done, because proportional to the power of the engines. We refer to a credit of ton-hours, which is found by multiplying the weight of the engine, expressed in tons, by the number of hours it is in service.

The maximum tractive power of an engine in road service is seldom used, except in starting its train or on long grades, conditions prevailing but a comparatively small part of the time the engine is working. In

switching service, however, the maximum tractive power, or very near it, is used most of the time. In calculating this maximum tractive power only the boiler pressure, the diameter and stroke of the cylinders and the diameter of the drivers are used. These factors, properly used, give the maximum power the engine is capable of developing, but it is the weight on the drivers which limits the amount of this power which is available for useful work. It, therefore, seems evident that, with switch engines, the weight on the drivers furnishes a simple and reasonably accurate unit for measuring their capacity for work. If this weight on the drivers, expressed in tons, is multiplied by the number of hours the engine is in service, it furnishes a credit of work done, expressed in ton-hours, which closely approximates the actual facts.

On almost all switch engines the weight on the drivers is the total weight, so that, with very few exceptions, if the total weight of the switch engines in working order, excluding the weight of the tender, is used in all cases, the per cent. of error would be small. Because of the insignificance of the error and because a number of roads are using the total weight of their engines as a basis for judging the efficiency of their shops making general repairs, we see no good reason why the total weight of the switch engines, exclusive of the tender, should not be used in determining their credit of ton-hours.

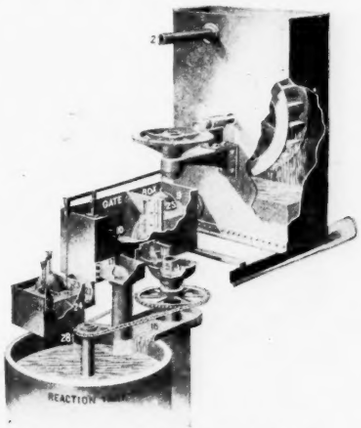
The ton-hour as a basis of statistics for switch engines has a number of advantages over the present credit of six miles an hour. The ton-hour is not arbitrary, but has a logical and reasonable basis; it is as easily figured as the mileage and will require the keeping of no records not now kept; it is a reasonably accurate measure of the work done and gives a basis from which to determine costs, which is proportional to the work done by the engines, because it takes into consideration both their power and the length of time they are at work.

The report is signed by C. H. Quereau, Chairman; G. R. Henderson, G. L. Fowler.

Re-agent Feeding Device for Water Softeners.

The accompanying illustration shows an automatic device used by the Industrial Water Company for regulating the feed of lime water and soda ash used in the water-softening process. The operation of the device is as follows: The rain water from the pump or gravity supply enters through pipe "2" and passes over the water wheel contained in the casing and then flows through a short connection to the float compartment 9 of the gate box. From here it flows through the high, narrow gate 26 to the distributing compartment 10, whence it flows in two streams through the gates, 11 and 17. The gate 11 is adjustable as to width, so that any desired percentage of the total amount of raw water may be made to flow through it, and then, by way of the chute, the bowl 12, and the pipe shaft 5, to the bottom of the lime tank. The lime water so produced flows through the chute 16 to the reaction tank and there mingles with the remainder of the raw water, which, having passed through the gate 17, goes directly to the reaction tank. The height of water in the distributing compartment 10 will vary as more or less water enters the machine, but the construction of the gates 11 and 17 is such that each will conduct its own fixed percentage of the total water flowing, regardless of the height of water in the compartment 10, and therefore regardless of the rate the water enters the machine. Thus, the percentage of raw water converted into lime water for subsequent mixture in the reaction tank with the remaining raw water, is fixed.

The method of feeding the soda is as follows: The soda ash solution flows from a vat through pipe 21 to the regulating box 22, the level of the solution in this box being maintained at a constant height by means of a balanced float valve. From the regulating box the solution flows, through the gate 23 in the side of this box, to the chamber 27, and thence, by way of the pipe 28, to the reaction tank. The gate 23 is, in effect, a miniature of the gate 26. It is covered by a sliding plate 24 connected by a rod and lever to the float 25 in the float compartment of the gate box. When water is not entering the machine this float 25 is at its lowest position and the top of the slide 24 is raised to its highest point (i. e., to the level of the soda solution in the box 22), thus closing the gate 23 and shutting off the flow of soda solution. When water enters the machine the float 25 rises and correspondingly depresses the slide 24 in such a manner that, when the water is flowing through the lower half only, of the gate 26, the slide 24 will be depressed half way, thus opening gate 23 half way of its height for the outflow of



Re-agent Feeding Device for Water Softeners.

soda solution. Similarly, when sufficient water is entering the machine to submerge (and, therefore, to utilize) three-quarters, or any other fraction of the gate 26, just three-quarters, or the same other fraction of the gate 23 will be uncovered for discharge of soda solution, the height of this solution in the box 22 remaining constant. The amount of soda solution fed to the water is strictly proportional to the quantity of water flowing and accuracy in the soda treatment is attained. The gate 23 is of adjustable width.

It is claimed that these two devices make it possible to treat raw water with absolute certainty and uniformity under all conditions of rate of flow. The rate of inflow of the raw water is automatically controlled by the demand for softened water, so that the machine is wholly automatic.

Chromic Myopia.

Dr. Mortimer Frank, of Chicago, has made some tests of the vision of that class of color-blind persons whose infirmity he calls chromic myopia; persons who can distinguish colors at a short distance, but not far off; and he gave some account of the tests in a paper read before the International Association of Railway Surgeons and the American Academy of Railway Surgeons at their recent joint meeting in Chicago. Incidentally, he noted the marked difference between signal glasses colored all the way through and flashed glasses. Of the glasses examined, he found red ones which transmitted some yellow and green rays, and greens which allowed red rays to pass through. Persons defective in color sense were confused by these glasses.

The tests were made to ascertain the relative transparency of a number of red and green glasses; to find the liability to mistake one color for another, and the distances at which the glasses could be seen. Of all the glasses tried, those made by John C. Baird, of Boston, proved the best, but that does not spoil the story. We need not give this portion of the report, as our readers are already acquainted with the merits of Mr. Baird's glasses.

In making the tests to determine how far a light of a given color could be seen, the observer moved back from the light until it was just on the point of vanishing in the darkness, and then measured the distance. Moving still further away until the light vanished, the observer now walked forward until the light was again visible, and the distance was measured. By repeating this several times, the relative vanishing distance was determined with accuracy. For the purpose of observation, regulation signal lanterns were used and stopped with a diaphragm having an aperture of 3/8 in., this corresponding to a distance of 20 ft. under a visual angle of five minutes. This size of opening was chosen so as to obtain a light feeble enough to disappear within the limits available for the purpose. In order to approach conditions of the railroad service, the tests were made at night and out of doors.

In the record below, A represents the examination of a person whose chromatic sense was good, when tested by Holmgren worsteds, but who was unable to recognize differences between colors at 20 ft. B represents the test of Dr. Frank himself.

VANISHING DISTANCES—RAILROAD COMPANY'S SIGNAL GLASS.

A.	Green	20 ft.
A.	Red	70 ft.
A.	White	30 ft.
B.	Green	45 ft.
B.	Red	80 ft.

NELS SIGNAL GLASSES.

A.	Green	45 ft.
A.	Red	95 ft.
B.	Green	More than 500 ft.
B.	Red	More than 500 ft.
A.	Nels yellow signal glass	More than 500 ft.

No exact values can be given for the vanishing distances of the Nels glasses under "B," and for the Nels yellow under "A." This is due to the fact that only a distance of 500 ft. was available and the lights still identified themselves at that distance. The actual vanishing values will be reported later, when the experiments have been carried out on a long tangent.

To test the relative transparency of the corresponding colored lights, lanterns were placed side by side with results as follows:

A.	Railroad company's green signal glass disappeared as a light at	80 ft.
	Nels green signal glass still visible as a light.	
A.	Railroad company's red disappeared as a light at	75 ft.
A.	Nels red still visible as a light.	
B.	Railroad company's green disappeared as a light at	80 ft.
B.	Nels green still visible as green.	
B.	Railroad company's red disappeared as a light at	80 ft.
B.	Nels red signal glass still visible as red.	

Photometric measurements of the relative

transparency of the glasses were made with a Bunsen photometer. Some colors affect the photometric readings more than others, but the results are nevertheless worth noting:

	Per Cent.
Light transmitted by Nels yellow.....	35.00
Light transmitted by Nels green.....	3.90
Light transmitted by Nels red.....	10.00
Light transmitted by R. R. company's green	1.5
Light transmitted by R. R. company's red.	5.1

In conclusion, Dr. Frank called attention to the risk involved in trusting men who have chromic myopia to read signals in high-speed train-working. Even in the case of moderate speeds the shortening of the view of a green or a red signal, for instance, would, in the case of dense fog or snow, greatly impair the ability of such a person to regulate the speed of the train, as compared with the ability of the same person in clear weather.

Forms for Concrete Work.

BY G. R. WADSWORTH.*

Now that concrete has come to be so extensively used for abutments, piers and retaining walls, the manner of finishing the exposed faces has passed through the experimental stages, until most excellent results, both in durability and appearance of the finished surface, are obtained. Since good practice does not sanction the application of a plaster finish after the concrete has finally set, the uniformity of texture and the accuracy of surface of the finished face must be obtained either by depending largely on the nicety of the forms, or by floating the surface of the masonry before the final set takes place.

Forms may be made, with great care, of selected lumber planed and sandpapered, with nails set and holes puttied. Bubble holes will generally appear in the finished face to a greater or less extent, depending on the amount of working the facing mortar received when applied to the forms. These are, of course, minor defects; a Portland cement wash brushed over the surface will eradicate most of them, and the result will be very satisfactory. Forms built as above are, however, expensive, both in labor and material, and less care is usually given to their erection, with the result that the demarcations of the boards, knots and often the grain of the lumber is apparent in the finished surface. At all events, forms of this type cannot be used a second time, on work where finish is an important feature, as the boards are split and dented when they are removed. In order to reduce the cost of forms per unit of masonry, at a greater first cost, if necessary, a panel type naturally suggested itself as being easy to erect and take down.

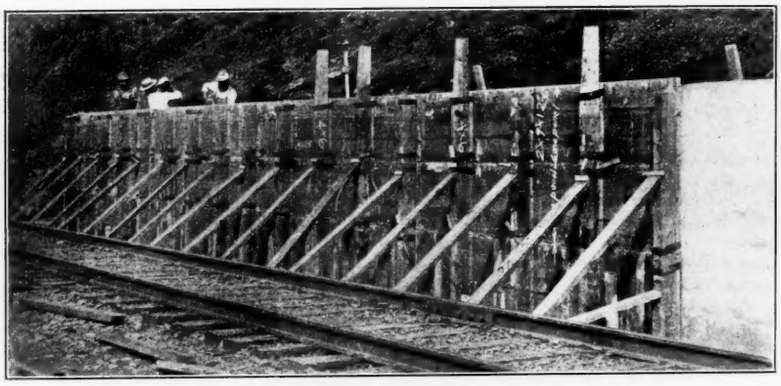


Fig. 1—Panel Forms, First Design—N. Y. C. & H. R. R. R.

This panel type was first designed and erected under the direction of Mr. Hugh Latimer, Asst. Engineer on the New York Central Lines, and as first used in illustrated in Fig. 1. This section was designed only with the idea of repeated use of the panels, and not with the idea of removing the lower ones and floating the surface before final set. These panels were used 16 times before becoming unfit for further use.

Fig. 2 illustrates the details of this panel design as finally adopted. This type has been used with eminently satisfactory results on retaining walls and abutments of considerable length, although it is less practicable for small pieces of masonry. The strap, wedge and block permit the lower panels to be drawn out endways as soon as the concrete has set sufficiently, and the surface is thus exposed and may be floated.

Fig. 3 shows a section of the retaining wall of the east approach to the Hudson River Freight Bridge of the New York Central at Albany. The panels that have just been drawn appear piled up at the base of the finished section, and the last panel of the row is being withdrawn. Concrete is being placed for the upper courses of the section, the lower portion has been finished, and the middle portion is being floated. The photograph illustrates the various operations very well. The concrete wall is built in 50-ft. sections, with vertical expansion joints between. The 10-ft. length of panels lends itself readily to

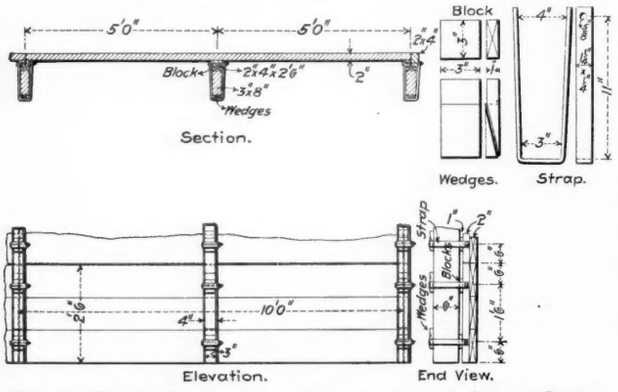


Fig. 2—Details Standard Panel Forms—N. Y. C. & H. R. R. R.†

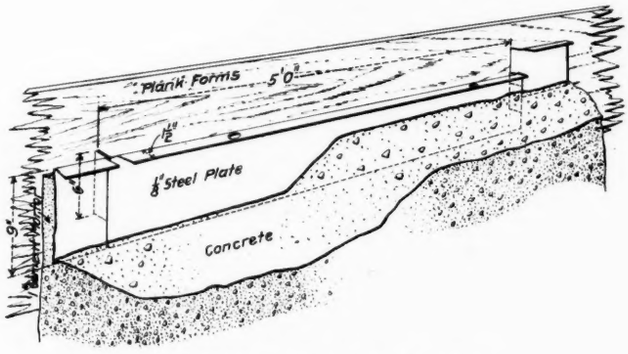


Fig. 4—Shield for Placing Facing Mortar.

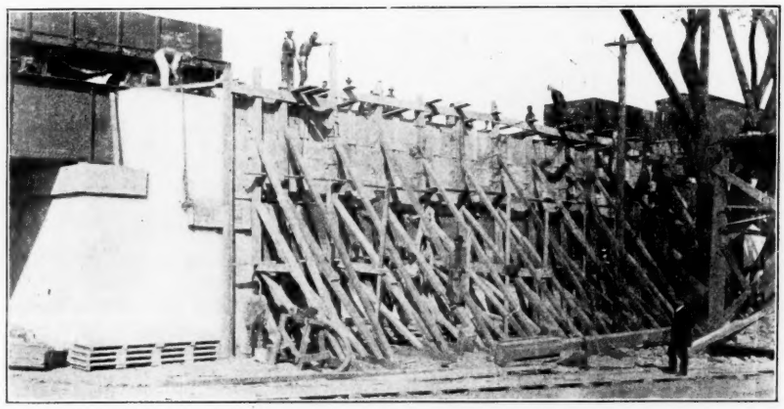


Fig. 3—Standard Panel Forms in Use—N. Y. C. & H. R. R. R.

*Assistant Terminal Engineer, New York Central

†Uprights should in all cases be securely braced from the rear, and no wires should be used. Forms should be erected in 50-ft. sections of five panels each, care being taken to get uprights set to proper batter, and panels level. Only the lower panels for a 50-ft. section to be placed first, the second being fastened in position when the concrete has been placed nearly to the top of the first panel. After the concrete has become partially set, so that the mortar face has reached the consistency of rubber, the first panels should be removed by drawing the wedges, removing the one-inch blocks, and drawing the panels out endways. The section of the face thus exposed should then be finished at once with water and wood float (no cement wash to be applied) until it is of a uniform texture, and all ridges and other imperfections of surface have been removed.

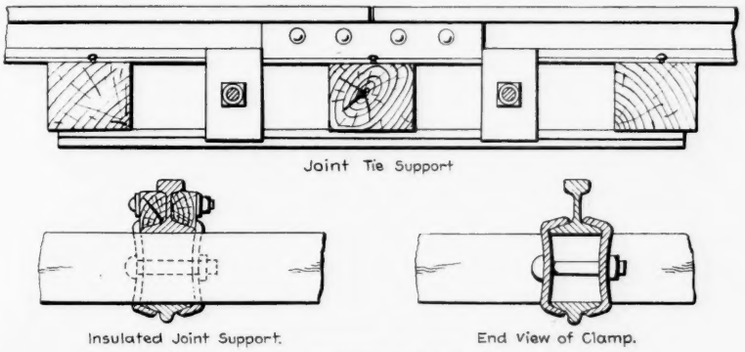
this procedure in sections of 50 ft., as six lengths will allow of 5 ft. lap on the preceding section and have room at the other end for the head forms for the section.

Fig. 4 illustrates a type of shield used with good results in connection with the movable forms, to insure a minimum thickness of facing mortar placed simultaneously with the backing. These shields are of sheet metal and are placed on the foundation course before beginning to place the concrete for the body of the wall. The mortar is placed between the shield and the wooden form, and after the 6-in. layer of backing concrete is placed, the shields are raised successively for each layer, and the backing concrete rammed so as to force it slightly into the facing mortar. The usual practice of placing the mortar against the forms with a trowel requires a much greater average thickness in order to insure a specified minimum thickness.

The Dickey Rail-Joint Support.

The rail-joint support shown in the engravings was devised by Mr. G. W. Dickey, Chicago. It consists of a length of standard T-bar placed below the ties immediately under and parallel to the track rails, and secured to the latter by clamps, as shown. The T-bar, which weighs 10 lbs. to the foot, is shallow, and its flange width is approximately equal to the width of the rail base. For tie joints the bar is 4½ ft. long, and for suspended joints 5½ ft. The clamps weigh 5 lbs. each, and are tied together by 1-in. bolts 8 in. long. The same principle is applied to supporting crossings, a suitable length of T-rail being clamped under the discontinuous track rail. The inventor estimates that the life of a support will be seven years in rock ballast. In cinder ballast it would, of course, be less. The cost per joint is $1.50.

One of these supports was applied last summer to a joint in the Lake Shore road in the city of Chicago, which had been giving considerable trouble. It was thoroughly tamped up at the time, and though it has had no attention since, the joint is still up to a good surface, while adjacent joints have required looking after several times. The



Elevation and Sections Dickey Rail-Joint.

Chicago Terminal Transfer and the Santa Fe have each placed trial orders for the supports. Mr. Dickey's Chicago address is 6006 Lafayette avenue.

The first year of the Swiss State railroads turned out very well, considering all the circumstances. There was a balance of only about $200,000 left; but the expenses include a sinking fund to retire the cost of purchase within 60 years, and the addition to employes' wages was about $700,000, and for maintenance and renewal of road and rolling stock $520,000. The working expenses were 65.53 per cent. of the gross earnings in 1903, against 61.11 in 1902. A further considerable increase in wages and a reduction of freight rates are to be made, which cause apprehensions for the immediate future.

A Metal Railroad Tie.

A patent on a metal railroad tie has been granted to Mr. S. B. Hoover, of Roca, Neb. Two illustrations of the tie are shown, giving a good idea of its form and appearance. Several objects were sought in designing the tie, important among which were (1) to secure a simple and durable construction adapted to fasten the rails firmly in position and prevent them from becoming accidentally displaced or moved out of alinement; (2) to provide a tie which will be held firmly in place without the need of embedding it on the roadbed, and (3) to provide a tie which will remain fixed in the position in which it is placed without having to provide some securing means therefor.

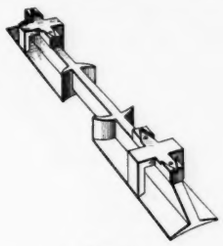


Fig. 1.

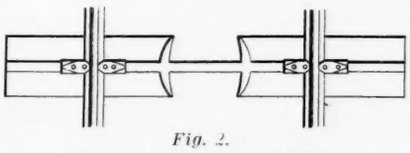


Fig. 2.

Hoover Metal Railroad Tie.

The tie, which is cast in one piece, consists of two similar end portions connected by a longitudinal rib or bar. This bar extends the length of the tie and is integral with a base having its lower face concaved, the object of which is to bring the edges firmly in contact with the roadbed and prevent lateral movement of the tie. To prevent longitudinal movement, laterally projecting wings at the inner end of each end portion are formed on each side of the central rib, their inner faces being concaved. The rail base rests on a table supported at the ends by standards extending upward from the edges of the base. Arms extend each way from the table along the top of the central rib, and the outer corners of these arms have angular lugs, which form a V-shaped recess on each arm. As will be seen from the plan view, Fig. 2, the rail is held by plates, which are steel and which fit into these V-shaped recesses, each plate being held by tap bolts, or other suitable means. The inner end of each plate fits over the rail base and abuts the web.

The inventor claims that it will be impossible with this tie for the track to get out of gage except by injury to the holding plates, in which case the latter may be reversed in position, both ends being formed to fit the V-shaped recess. Also that any chance to center-bind is avoided by the omission of the base at the center. Furthermore, that these ties will require only one-half the ballast that is needed with wooden ties because of the wings at the inner ends of the end portions, there being no need of ballast outside of these; and that being self-tamping and self-draining the track can be kept in better shape with less work than with wooden ties. The estimated weight of the tie is 156 lbs.

The Argentine Railroads in 1900-1901.*

The Argentine railroads are making more favorable progress than formerly, and of late the railroad system has been extended, especially with a view to increasing railroad traffic with neighboring countries, and with Chile and Bolivia in particular.

In Argentina, as in our country, the railroads are the precursors of means of transportation. English capital soon recognized this fact and developed the railroad system. The government, too, assisted the movement by putting railroad materials on the free list and by guaranteeing interest as well as by subsidizing the railroads with land, both agricultural and mining. The government also subscribed to the capital fund. The first great railroad system built with the assistance of the government was the Central Argentine Railroad running from Buenos Ayres to Cordoba in the center of the country. This road received a guarantee of interest and also a substantial land grant and exemption from taxes, all with a view to attracting foreign capital to railroad building. In the case of railroads built later the government did not find it necessary to be as liberal in its subsidies, but still contributes largely to the cost of new lines.

The relation of the government to the railroads has been much influenced by the precedent of Germany, although government ownership in Argentina is practically out of the question, as it would entail an expenditure of about $650,000,000. Equally impracticable would be a policy similar to the Belgian method of paralleling the private railroads with government lines. The government in Argentina has followed the opposite course and has sold off some of its own railroads, but has striven to secure a fair degree of uniformity and harmony among the private lines. Conditions similar to those existing in the United States are apparent. Competition among the railroads and their growing monopoly has led to many difficulties, and legislation has been aimed at controlling this monopoly. Now railroads are chartered for a limited period of time, and are subject to government purchase at an appraised value. Moreover, the sale or lease of railroads is now subject to government approval. The government exerts itself to secure just treatment of the public and harmonious action among the various railroads. The separate local jurisdictions of the several provinces have created much confusion and have seriously stood in the way of developing through

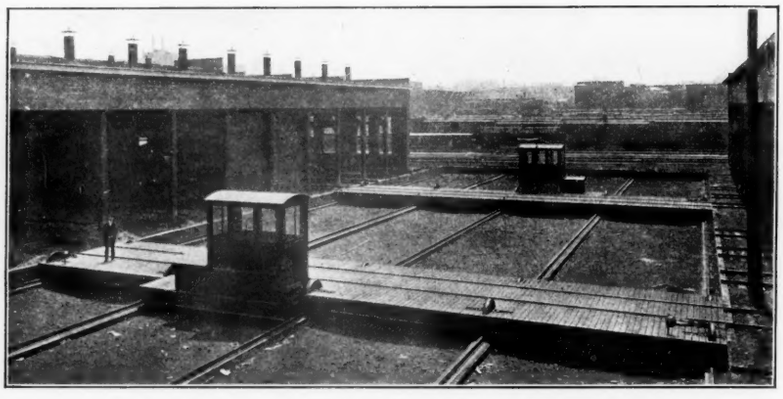
*Abbreviated from the "*Archiv für Eisenbahnwesen*," May and June, 1904.

traffic. The government has done much to influence the rate policy with a view to encouraging traffic between the various provinces.

In general, the government has had little direct influence in fixing rates on the railroads. Nominally, it can interfere in the case of rates that enable the railroads to net more than a certain percentage on their capital. By decree of November, 1899, the existing "exceptional" rates are subject to the approval of the government. The matter of freight classification also comes within government jurisdiction, and some progress has been made in preventing discrimination.

The great difficulties to be contended with are the lack of uniformity in railroad equipment, the difficulty of securing through rates and the publishing of a uniform tariff schedule, besides which complaints are frequently heard of a lack of rolling stock and of warehouse and other terminal facilities. In the past few years there has been a strong movement toward railroad consolidation; for instance, the Santa Fe & Cordoba Southern Railroad was consolidated with the Rosario Railroad in 1900, and the West Santa Fe Railroad with the Central Argentine Railroad. This consolidation of railroads has strengthened the position of the private railroads against the government. The government railroads, as compared with the private railroads, have been far from financially successful. They have not been well managed and in some cases have been sold to private corporations. Much is expected as the result of opening a government railroad to Bolivia. The traffic in india rubber and various ores offers great inducement to a through route with that country. The engineering difficulties are serious. The government, however, hopes to build a profitable railroad northward into Bolivia and to compete successfully with the other routes to the seaports. In 1894, Bolivia and the Argentine came to an agreement about building this international railroad, the Argentine government furnishing the capital. Work was begun in 1896, but in 1902 the construction of the railroad was put in the hands of a private corporation.

The international railroad between the Argentine and Chile, across the Andes, is not quite completed. Both financial and strategic reasons have delayed its completion. The Argentine section is practically finished. It is a narrow gage road, and it is therefore of different gage from the railroads of the two countries it connects. Thirty-six miles of line are yet to be built. During the summer months, traffic by mule connects the two links of the complete railroad system. The eventual railroad is to cross the Andes by a tunnel nearly 16,000 feet above the sea level. The Chilian act of February, 1903, opens the way to the completion of the link. The government guarantees 5 per cent. on the capital of $7,500,000 for twenty years. The completion of this international railroad will not seriously affect the water transportation from the Atlantic to the Pacific, though it will shorten the distance from Europe to Chile by 6 or 8 days. Freight rates will necessarily be high, and freight will have to be transshipped at several points. Passenger traffic will be somewhat affected by the existence of this shorter route. Even in 1902 this land route was used by 5,000 people as against 1,000 persons who passed from the Atlantic to the Pacific ports in question by the Straits of Magellan.



Rectangular Engine Houses with Transfer Tables.
Terminal Railroad Association of St. Louis.

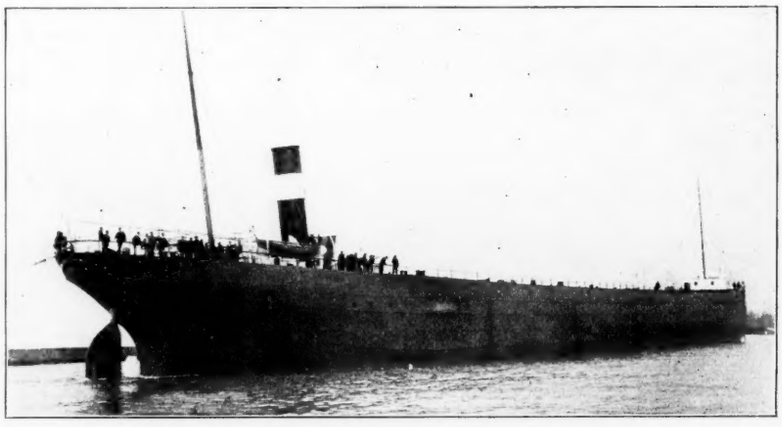
Rectangular Engine Houses at St. Louis.

Several references have already been made in these columns to the rectangular engine houses of the Terminal Railroad Association of St. Louis. There are three houses of 12 stalls each, served by four transfer tables, two in each pit. A view of one of these table sets, and of parts of two of the houses, is shown in the engraving herewith. The houses are brick, with gable roofs of low pitch, and have steel rolling doors.

The tables are 75 ft. long and of 175 tons capacity. They travel 125 f.p.m. loaded and 300 f.p.m. light. As they are used both night and day, an incandescent light, backed by a reflector, is placed at each end close to one side to enable the operator to line the track without trouble at night. Also, on top of the cab is a signal light which normally shows red, and inside is a tell-tale of the same color. When the table has been placed for a waiting locomotive the operator notifies the man in charge by changing the signal to green. The tables were furnished by Geo. P. Nichols & Bro., Chicago.

New Steamer A. W. Wolvin.

The new steamer A. W. Wolvin, shown in the accompanying photograph, is the largest vessel ever built on the Great Lakes, and is of especial interest because it is the first cargo carrier designed especially to meet the conditions of the new automatic ore unloaders which have been installed at Lake Erie ports for the purpose of transferring the bulk material wholly by mechanical means from the ships to the cars which convey it to the blast furnaces in the so-called Pittsburg district in Ohio and Pennsylvania.



The A. W. Wolvin—Largest Vessel on the Great Lakes.

In order to facilitate the operation of the "clam-shell" buckets of the automatic unloaders and enable them to scoop up the ore without the assistance of any hand shovelers the hold of the Wolvin is built in the form of a hopper with sides that slope from the main deck down to the tank top and the ends built on the same slope. This hopper extends in one continuous length of 409 ft. without bulkheads or divisions of any kind and is 43 ft. wide at the top and 24 ft. at the bottom. Several of the automatic unloaders may be operated simultaneously inasmuch as the deck of the Wolvin is pierced by 33 cargo hatchways, each measuring 33x9 ft. in the clear and spaced 12 ft. apart. These hatchways are fitted with a system of steel plate sliding hatch covers operated by steam engines.

The Wolvin is 560 ft. long over all, 540 ft. keel, 66 ft. molded beam at the widest part and 32 ft. deep amidships. Her length is just double that of the Cambria, the first steel vessel built on the Great Lakes, which went into commission in 1887. The main engine of the new vessel is of the quadruple four-cranked type, with cylinders 18½, 28½, 43½ and 66 in. in diameter and 42 in. stroke, designed for an indicated horse-power of 2,000 when making 80 r.p.m. Steam is generated in two Babcock & Wilcox boilers working at a pressure of 250 lbs. per sq. in. The vessel cost $480,000, has 500,000 cu. ft. of cargo space and will be capable of carrying 12,500 tons of coal or 401,000 bu. of grain on a draught of 18½ ft. The coal bunkers have a capacity of 360 tons and the vessel is fitted with electric lighting plants in duplicate, so as to be prepared for any emergency which would incapacitate one plant.

GENERAL NEWS SECTION

THE SCRAP HEAP.

A press despatch from San Francisco says that 1,000 men were discharged from the shops of the Southern Pacific on June 30.

At Asheville, N. C., a large number of suits have been brought against the Southern Railway to enforce the penalty for failure to provide cars when demanded by lumber shippers.

The Western Maryland has asked for bids for the construction of two coast schooners and two large coal barges with a view to entering into the New England trade for the purpose of stimulating its soft coal traffic.

The Brooklyn Rapid Transit Company, Brooklyn, N. Y., has sent an agent to colleges in Montreal and elsewhere to let it be known that the company would like to hire students to work as street car conductors during the summer.

In the Federal Circuit Court at St. Louis, in a suit brought by the Illinois Central, three ticket brokers, E. J. and C. J. Gildersleeve and L. Tillman, have been fined $250 each and costs for contempt of court in violating the injunction which prohibits the selling of certain World's Fair excursion tickets.

The Metropolitan Express Company, a comparatively new establishment running electric express cars from Manhattan (New York) to Yonkers, Mount Vernon and other places in Westchester County, and which has built up a large business, has been leased to the American Express Company for 16 years. The Metropolitan has important real estate holdings, having established stations, with side tracks, at many points, and a valuable contract with the Metropolitan Street Railway, over whose tracks its cars are run.

B. & M. Elevator Destroyed.

On the night of July 5 the great grain elevator of the Boston & Maine, at Charlestown, with freight houses 1, 2 and 3 on piers 1 and 2, at Mystic Wharf, were destroyed by fire, and the loss is expected to exceed $1,000,000. The steamer "Austrian," lying at the pier, caught fire, and of 11 sailors who jumped overboard to save themselves three were drowned. The fire started in a hay shed, which was struck by lightning. The capacity of this elevator was 2,000,000 bushels; the quantity of grain burned was about 100,000 bushels.

Wireless Telegraph Contracts.

After competitive tests of different systems, the Bureau of Equipment, Navy Department, has arranged with the American DeForrest Wireless Telegraph for the use of the Navy, for five of the longest wireless telegraph circuits yet used, two of them being over 1,000 miles long. The company will supply wireless instruments for use between Key West and Panama, 1,000 miles; Porto Rico and Key West, 1,000 miles; South Cuban coast and Panama, 720 miles; Pensacola and Key West, 450 miles; South Cuba and Porto Rico, 600 miles.

Disastrous Train Wreck at Litchfield, Ill.

On the night of July 3, about 7 o'clock, the southbound limited express train on the Wabash was derailed at a misplaced switch at Litchfield, Ill., and 20 or more persons were killed. The engine and the first two or three cars were overturned. The wreck took fire and only two of the nine cars of the train were saved from the flames. The last reports indicate that 18 passengers and 2 employees were killed or fatally injured, many of them being burned to death, and 40 or more persons were more or less severely injured. One press despatch says that the switch had been maliciously misplaced.

Victorian Railways (Australia).

The recent report of the Victorian Railways in Australia for the quarter ending March 31, 1904, is most gratifying, as showing the rapid strides these roads have taken since they were placed in the hands of the Board of Railroad Commissioners in June, 1903. During this quarter, gross earnings have increased $1,366,510. Operating expenses, on the other hand, have increased only $261,145, leaving the handsome gain in net of $1,105,365. The percentage of operating expenses to gross earnings for this period was only 45.09, as against 54.03 during the same three months in 1903. As the commission has only been working for nine months, the report is most creditable and great praise is due to Mr. Thomas Tait and his associates for the work accomplished.

Motor Car Service in England.

The new summer time-table of the Great Western of England shows a number of motor car schedules on branch and suburban lines. The new line just opened between Honeybourne and Broadway will be operated entirely with motor cars. Eight new auto-car routes have been established on the highways between stations on the company's lines and interior towns. Some disagreements have arisen with the town and county authorities about the responsibility for the condition of the highways over which these cars are run, and this has temporarily checked the expansion of this promising scheme of the railroad to build up its local passenger traffic. It is also reported that the Midland will introduce steam motor cars on its Hitchin and Bedford branch. One of the cars which is to be used on this line has just been turned out from the company's Derby shops. On the trials made with it, a speed of 56 miles an hour was sustained on the level and 53 m.p.h. on a grade of 88 ft. per mile. The car is 60 ft. long over buffers. It is divided into four compartments, and about 60 passengers can be carried, but the fares will be the same in all.

Disciplining Telegraph Operators.

The Delaware, Lackawanna & Western issues periodically a circular to operators, informing them of shortcomings observed, and calling attention to the rule covering each case of dereliction.

The method of statement is as follows:

1. Despatcher called an office for 25 minutes, operator finally responding by O-S-ing two trains. The despatcher instantly sent a message to him. Operator failed to get it: had left wire without listening for anything that might be said to him. This is a bad practice and must be discontinued.

2. Train wire left open in train order office 10 minutes, not discovered by operator until called on another wire and "direction open" not reported by any other. Very careless. See Rules 327 and 334.

3. Operator permitted student to handle train order in violation of Rule 321. Student "bulled" it, causing confusion and delay.

7. The front portion of a train "parted" passed. Operator O-S'd without noticing absence of markers. Delay of one hour to passenger train resulted. Another O-S'd a fast freight "BY" when engine passed office, while train stopped with rear end at station 18 minutes. Operator neither notified despatcher nor found out cause of delay. A train must not be reported until markers have passed. Despatchers are responsible for train movements and must be kept fully informed by operators, upon whom they must depend for full and correct information.

8. Despatcher called attention of operator to neglect, and he replied with insolence, vulgarity and profanity. He was immediately taken out of the service. Despatchers are held responsible for deportment of operators by Rule 369. Insubordination and improper language will not be tolerated. Two men are off now for sleeping on duty and one for not being prompt with O. S. Give preference to all business with despatchers and in connection with train movement. Do not fight for circuit.

14. Day and night operators changed off two days. A day operator had night man work until noon. Another absented himself two days account sickness, arranging with bill clerk (an operator) to do his work without permission from this office. See Rule 303.

15. Night operator left before day man came and important message was overlooked. Day man left office before being relieved and wreck train was delayed one hour. Day operator failed to notify night man of train order signal out of order; precaution on part of despatcher prevented trouble. See Rule 305.

There has been a marked improvement in observance of rules and in service since introduction of circular notices; an improvement that has also been observed where similar methods have been followed under the "Brown" system of discipline.—*Train Despatchers' Bulletin.*

The Iron and Steel Institute.

A provisional program has been issued by Secretary B. H. Brough, 28 Victoria street, London, for the autumn meeting in the United States. The reception committee in America has for its officers John Fritz, president; Charles Kirchoff, chairman of the executive committee; Robert E. Jennings, treasurer and Theodore Dwight, 99 John street New York, secretary. The arrangements for ocean transport have been placed in the hands of Messrs. Thomas Cook & Son. Most of the members are expected to arrive in New York on October 21, 22 and 23. The headquarters will be at the Hotel Astor, 44th street and Broadway, which will be open to the public by September 1. For the entertainment of the members during their stay in New York, a reception committee has been formed, including the following: James A. Burden, G. W. Maynard, Stephen W. Baldwin, L. W. Francis, C. A. Moore, E. E. Olcott, Thos. Robins, Jr., T. C. Martin and Dr. R. Moldenke, secretary. On Monday, Oct. 24, the New York Committee will arrange for optional excurisons in power houses, bridges, industrial establishments, universities, the navy yard, subway and other places of interest, with boat trips around the harbor and drives in the parks for ladies. The opening of the annual general meeting of the Institute occurs in the evening, followed by a reception. Tuesday will be devoted to an excursion up the Hudson on a specially

chartered Albany boat, stopping at West Point. On Wednesday there will be two meetings of the Institute for the reading and discussion of papers. In the evening the Institute will entertain the Reception Committee at dinner at the Waldorf-Astoria, and a theatre party is to be arranged for the ladies. On Thursday the party will leave New York in the morning for Philadelphia. Friday will be spent in Philadelphia, and on Saturday special trains will leave for Washington, where there will be a reception in the evening by the President of the United States.

Sunday will be spent in Washington, and on Monday the party will leave for Pittsburg. Tuesday, Wednesday and Thursday will be spent in Pittsburg, and on Friday the main party will leave in the morning for Cleveland. On Saturday the party will leave Cleveland and arrive at Buffalo, spending the night and Sunday there. Those who wish to stop at Albany to visit the General Electric Company's plant can do so, both parties arriving in New York on the evening of Tuesday, November 8, in time for the steamer leaving for England on Wednesday. During the stay in Buffalo the party will be taken to Niagara and given ample opportunity to see the falls. The party traveling entirely by day, will only have to take two or three meals on the trains, and it may be estimated that the total cost for the main trip will be $125.

For the convenience of members desirous of visiting the St. Louis Exhibition, arrangements will be made for a limited number to leave Pittsburg, November 3, evening, for St. Louis and Chicago, returning to New York in time for the steamer leaving Saturday, November 12. This trip will necessitate three nights in sleeping cars, and the approximate cost will be $175. Friday, Saturday and Sunday will be spent at St. Louis, leaving Monday night for Chicago. The party will leave Chicago on Tuesday night for Buffalo, spending Wednesday, Thursday and part of Friday there.

Sixteen New Interlockings in Texas.

The State Railroad Commissioners of Texas have issued orders to the railroads named below to put in interlocking signals at the crossings mentioned, and to have them ready for operation by June 30, 1905:

Dallas Terminal & Union Depot:

1. Crossing with Houston & Texas Central at Coombs street, Dallas.
2. Crossing with Gulf, Colorado & Santa Fe at Grigsby avenue, Dallas.

Galveston, Harrisburg & San Antonio:

1. Crossing with International & Great Northern at San Antonio.
2. Crossing with Gulf, Colorado & Santa Fe near Harrisburg.

Galveston, Houston & Northern:

1. Crossing with Galveston, Houston & Henderson near bay bridge, Galveston.

Galveston, Houston & Henderson:

1. Crossing with Galveston, Houston & Northern near bay bridge, Galveston.

Gulf, Colorado & Santa Fe:

1. Crossing with Dallas Terminal & Union Depot railway at Grigsby avenue, Dallas.
2. Crossing with Galveston, Harrisburg & San Antonio near Harrisburg.
3. Crossing with Houston & Texas Central, South Fort Worth.
4. Crossing with St. Louis Southwestern of Texas, Wylie.
5. Crossing with Texas & Pacific, Texas Midland, Paris, & Great Northern at Paris.
6. Crossing with Missouri, Kansas & Texas of Texas, Garland.

Houston & Texas Central:

1. Crossing with Dallas Terminal & Union Depot railway, Coombs street, Dallas.
2. Crossing with Gulf, Colorado & Santa Fe, South Fort Worth.
3. Crossing with Missouri, Kansas & Texas of Texas, Waxahachie.
4. Crossing with International & Great Northern, Marlin.

Houston East & West Texas:

1. Crossing with International & Great Northern east of Houston.

International & Great Northern:

1. Crossing with Galveston, Harrisburg & San Antonio, San Antonio.
2. Crossing with Houston & Texas Central, Marlin.
3. Crossing with Houston East & West Texas east of Houston.
4. Crossing with Missouri, Kansas & Texas, of Texas, New Braunfels.

Missouri, Kansas & Texas of Texas:

1. Crossing with Gulf Colorado & Santa Fe, Garland.
2. Crossing with Houston & Texas Central, Waxahachie.
3. Crossing with International & Great Northern, New Braunfels.
4. Crossing with St. Louis Southwestern of Texas, Carrollton.
5. Crossing with St. Louis Southwestern of Texas, Greenville, Dallas division.
6. Crossing with Texas & Pacific, Mineola.

Paris & Great Northern:

1. Crossing with Gulf, Colorado & Santa Fe, Texas Midland, Texas & Pacific, Paris.

St. Louis Southwestern of Texas:

1. Crossing with Gulf, Colorado & Santa Fe at Wylie.
2. Crossing with Missouri, Kansas & Texas of Texas at Carrollton.
3. Crossing with Missouri, Kansas & Texas, Dallas division, at Greenville.

Texas and Pacific:

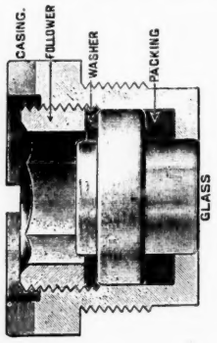
1. Crossing with Missouri, Kansas & Texas at Mineola.
2. Crossing with Gulf, Colorado & Santa Fe, Texas Midland, Paris & Great Northern, at Paris.

Texas Midland:

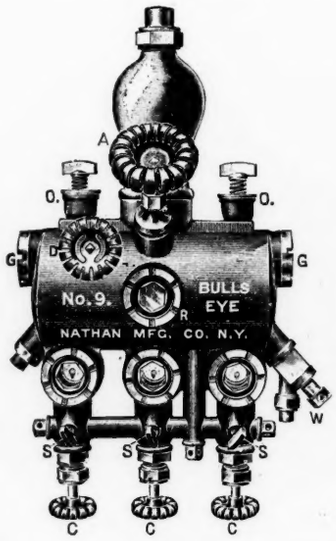
1. Crossing with Gulf, Colorado & Santa Fe, Texas & Pacific, Paris & Great Northern, at Paris.

The Nathan "Bulls Eye" Lubricator.

The "Bulls Eye" locomotive lubricator shown in the accompanying illustration is made by the Nathan Manufacturing Company, and is known as "Class B. E." One of the principal features of this lubricator



is the substitution of a new form of disk glass in place of the usual tubular form. This new disk glass is practically non-breakable under any service conditions. The oil reservoir is cylindrical. Hand oilers are provided for the cylinder feeds and gage glasses are provided, which indicate when the reservoir is nearly empty. A reserve glass is carried on the casing of the lubricator. The disk glasses are packed in castings, as shown. These casings screw into the body of the lubricator and can be easily removed for inspection or repairs. A front view of the lubricator is shown, in which "A" is the filling plug, "D" the water valve, "O" the hand oilers, "S" the sight-feed drain



valves, "C" the regulating valves, "G" the gage glass, "R" the reserve glass and "W" the waste cock. In attaching the lubricator no special valve attachments are required. It is only necessary that the steam chest oil plug be provided at its lower end with a bore of not less than 3/32 in. or more than ⅛ in. diameter.

C. W. Hunt Co.'s Exhibit at St. Louis.

The C. W. Hunt Co. has an interesting exhibit of the Hunt "Industrial" railway system at the St. Louis Exposition. A track has been laid around the circumference of the court in the Palace of Electricity, and on it is run an electric storage battery locomotive hauling two shop cars. Seats have been placed on the flat top of each car, and these are used to carry interested visitors, while the operator is describing in detail the purposes and mechanism of the locomotive and railway. In the loggia of the court the same company is exhibiting a straight line electric hoist, together with photographs of plants which have been equipped with coal-handling machinery, of which this company is the pioneer maker.

Manufacturing and Business.

The Weller Roller Mill & Forge Co., of Anniston, Ala., it is reported, will enlarge its works. This company makes railroad spikes.

It is expected that a company will be organized at Clinton, Tenn., with a capital of about $600,000, to build a foundry and machine shop.

The Railway Appliances Company, Chicago, has been appointed exclusive agent for the United States for the railway trade of the Olds Motor Works, Detroit and Lansing, Mich.

The L. H. Prentice Co., of New York City, has been incorporated with a capital of $300,000, to make machinery. The directors are: L. H. Prentice, Chicago; W. L. Canfield and O. F. Hibbard, New York.

The Muskogee Bridge & Structural Iron Company has been incorporated with a capital of $50,000; principal offices at Muskogee, Ind. T. The officers are: J. S. Weeks,

President; N. R. Haskell, Vice-President, and J. L. Weisner, Secretary and Treasurer.

The Broderick & Bascom Rope Co., St. Louis, closed its factory on June 25, to allow its 300 or more employes to attend the World's Fair. The company provided tickets for the employes and their families, and also paid for their entertainment on "The Pike."

The firm of Waddell & Hedrick has opened offices in Toronto and Montreal, Canada, with the DeLano-Osborn Engineering Company as representatives, the object being to secure the engineering work on large and important bridges throughout the Dominion of Canada. This firm is already doing considerable work in the Dominion.

The New York Contracting Company, Pennsylvania Terminal, of New York City, has been incorporated in New York with a capital of $100,000. The directors are J. J. Murphy, E. I. Gaffney and G. H. Allison, of New York City. The contract for excavating the site of the Pennsylvania passenger station in Manhattan was recently awarded to the New York Contracting and Trucking Company. The officers and directors of that company and this are identical. The excavation work will be begun this week.

Wm. H. Armstrong, recently New York Manager of the Chicago Pneumatic Tool Co., and W. Kearns, Southern Sales Agent for the same company and previously with the Standard Railway Equipment Co., have started business under the name of Kearns & Armstrong in the Chamberlain building, Norfolk, Va. John F. Allen, of New York, has entered into an agreement with them for the exclusive sale of the Allen riveters in the District of Columbia, Virginia, North and South Carolina, Florida, Georgia and Alabama.

The Directors of the Locomotive & Machine Co., of Montreal, have elected A. J. Pitkin president, to fill the vacancy caused by the death of S. R. Callaway. J. E. Sague is first vice-president; R. J. Gross, second vice-president, and C. E. Patterson, comptroller. The directors authorized the expenditure of $300,000 for the purchase and installation of new machinery and equipment and enlargement of buildings. The company is building engines for the Canadian Pacific, the Grand Trunk, the Quebec Central and other lines in Canada.

Iron and Steel.

S. Pearson & Son, Limited, who are in the market for 104,000 tons of castings for the east section of the Pennsylvania tunnel, are considering the question of buying or leasing a foundry, being dissatisfied with prices asked by bidders.

Isaac N. Scott, formerly connected with the Steel Corporation as Auditor of the American Sheet Steel Co., has been elected President of the La Belle Iron Co., to succeed John A. Topping. The latter has resigned to become President of the American Sheet & Tin Plate Co., of the United States Steel Corporation.

The Harriman roads, it is reported, have ordered 60,000 tons of rails, to be delivered this year; 10,000 tons will go to the Union Pacific and a similar amount to the Oregon Short Line; 20,000 to the Houston & Texas Central, and 20,000 to the Southern Pacific. The orders were divided among the United States Steel Corporation, the Tennessee Coal & Iron Co. and the Pennsylvania Steel Co.

At a recent meeting of the LaFollette Coal, Iron & Railway Co. at LaFollette, Tenn., funds were voted for the building of a second blast furnace and to enlarge the company's coke plants. A new furnace will be built at once and will be a duplicate of the present furnace. The officials re-elected were: H. M. LaFollette, President and General Manager; R. B. Winkler, Vice-President, and H. M. LaFollette, J. S. Bartlet and R. P. Clapp, Executive Committee.

MEETINGS AND ANNOUNCEMENTS.

(For dates of conventions and regular meetings of railroad conventions and engineering societies see advertising page 30.)

American Institute of Electrical Engineers.

The International Electrical Congress will convene at St. Louis September 12, 1904. The opening ceremonies will be held in the Music Hall of the Coliseum. On September 14 the annual convention of the American Institute of Electrical Engineers will be opened at Festival Hall in the grounds of the Louisiana Purchase Exposition. A topical discussion will follow between the Institution of Electrical Engineers of Great Britain and the American Institute of Electrical Engineers. Up to June 22, 1778 persons had signified their desire to become members of the congress, of whom 286 were residents of countries outside the United States and Canada. Up to the same date 104 American papers and 56 foreign papers had been promised. The fee for membership in the Congress is $5.00, which may be forwarded either to the secretary, Dr. A. E. Kennelly, Harvard University, Cambridge, Mass., or to the treasurer, Mr. W. D. Weaver, 114 Liberty street, New York city. The work of the Congress will be divided into eight sections as follows: General theory; general applications; electrochemistry; electric power transmission; electric light and distribution; electric transportation; electric communication; electro-therapeutics. An interesting trip has been arranged for visiting members. Particulars can be obtained from R. W. Pope, 95 Liberty street, New York.

PERSONAL.

—Mr. W. H. Firth, General Passenger Agent of the Chicago, Rock Island & Gulf, died suddenly in his office at Fort Worth, Texas, last week.

—Mr. George A. Mountain, Chief Engineer of the Canada Atlantic Railway, has been appointed Consulting Engineer of the Canadian Railway Commission. Mr. Mountain has been in the service of the Canada Atlantic for the past 23 years, and is about 44 years old.

—Mr. Theodore N. Ely, Chief of Motive Power of the Pennsylvania Railroad, has received from Hamilton College the honorary degree of Doctor of Science. Mr. Ely is a graduate of Rensselaer Polytechnic Institute, from which he received his degree as civil engineer, and he holds the honorary degree of M. A. from Yale.

—Mr. Arthur H. Fetters, Mechanical Engineer of the Union Pacific, is a graduate of Lehigh University. After graduating he entered the employ of the Baldwin Locomotive Works, with whom he served at various times for about six years. In 1899 he was made Chief Draftsman on the Erie Railroad, but about three years ago he returned to the Baldwin Locomotive Works. When he went to the Union Pacific he was Chief Draftsman at Omaha. Afterward he was made Assistant Mechanical Engineer, and now is promoted to be Mechanical Engineer.

—Mr. Frank Taylor Hyndman, who for the past three years has been Master Mechanic at Du Bois and whose promotion to be Superintendent of Motive Power of the Buffalo, Rochester & Pittsburg, was recently announced, is 46 years old. He entered railroad service in 1872 as a machinist apprentice on the Central of New Jersey at Ashley, Pa. For three years from 1874 he was in the Wilkesbarre shops of the Lehigh Valley. In 1880 he was on the Atchison, Topeka &

Santa Fe as a machinist at Raton, N. Mex., and thence went to the Pittsburg & Western and the Pittsburg Locomotive Works. From 1883 to 1895 he was on the Pittsburg & Western, and in September of the latter year was made Trainmaster, later being promoted to be Master Mechanic. In 1901 he went to the Buffalo, Rochester & Pittsburg, where he was made Master Mechanic, and from that position he is now promoted to succeed Mr. Turner. Mr. Hyndman's office will remain at Du Bois.

—Mr. R. L. Ettenger, the new Consulting Mechanical Engineer of the Southern Railway, was born in Richmond, Va., in 1864, and was educated in that city. His first railroad work was in 1885, when he entered the services of the Chesapeake & Ohio as a draftsman. Two years later he was made Chief Draftsman. In 1889 he resigned and went

to Duluth as Engineer in charge of Construction for the Minnesota Car Company; here he was soon promoted to be General Superintendent, and held this position until the works were closed in 1896. For a time he did special work for the Duluth & Iron Range Railroad. In 1897 he was appointed Mechanical Engineer of the Cleveland, Cin-

cinnati, Chicago & St. Louis at Indianapolis, which position he now leaves to succeed Mr. Hibbits on the Southern.

ELECTIONS AND APPOINTMENTS.

Chicago, Burlington & Quincy Railway Company.—The lines of this company are now operated as two grand divisions, known as "Lines East of the Missouri River" and "Lines West of the Missouri River," each being under the jurisdiction of a general manager. The lines east of the Missouri River are subdivided, as shown in the next paragraph. The grand division west of the Missouri river is subdivided into five operating divisions (as heretofore), known as Lincoln division, Wymore division, McCook division, Alliance division, Sheridan division.

General Manager Delano of the lines east of the Missouri River, announces the following changes: H. D. Judson is appointed General Superintendent of the Illinois district, with headquarters at Chicago; F. C. Rice, heretofore general superintendent of the C., B. & Q. R. R., is made General Inspector of Transportation for the whole C., B. & Q. system. The Illinois district comprises the—

Chicago division (formerly known as Chicago terminals).
Aurora division (formerly known as Chicago division).
Galesburg division.
Beardstown division (formerly the St. Louis division).
La Crosse division (formerly the Northern division).

H. C. Nutt is appointed General Superintendent of the Iowa district, with headquarters at Burlington. The Iowa district comprises the—

Burlington division.
Ottumwa division.
Creston division.

Henry Miller is appointed General Superintendent of the Missouri district, with headquarters at St. Louis. The Missouri district comprises—

Hannibal division (formerly the St. L., K. & N. W.).
Brookfield division (formerly the H. & St. J.).
St. Joseph division (formerly the K. C., St. J. & C. B.).
Centerville division.

The division officers on the divisions, the names of which have been changed, will take corresponding positions on the newly named divisions. There will be no changes in the jurisdiction of division officers or in accounting divisions except as follows: The Chicago division is extended to mile post 36 at the east end of Aurora yard, and the Superintendent of the Chicago division will have jurisdiction over both freight and passenger business. The Superintendent of the Aurora division will have the same jurisdiction as the Superintendent of the old Chicago division, with the exception of the deduction of the mileage east of mile post 36, and the addition of the mileage from Mendota to and including Zearing yard, mile post 96. The jurisdiction of the Superintendent of the Galesburg division will remain as heretofore, with the exception of the deduction of the mileage from Zearing to Mendota, which now becomes part of the Aurora division.

L. A. Howland is appointed Assistant to the General Superintendent of the Illinois district, and as such will be the Superintendent of the General Office Building, at Chicago, and have general supervision over main line passenger train service. The jurisdiction of F. H. Clark, Superintendent Motive Power; F. A. Torrey, Assistant Superintendent Motive Power, and the Mechanical Engineer's office is extended to include all of the lines east of the Missouri River. (See Hannibal & St. Joseph.)

Chicago, Cincinnati & Louisville.—B. H. Harris has been appointed Freight Traffic Manager. The position formerly held by Mr. Harris, General Freight Agent, has been abolished.

Cleveland, Cincinnati, Chicago & St. Louis.—R. L. Ettenger, Mechanical Engineer, has resigned. (See Southern.)

Hannibal & St. Joseph.—The accounting offices have been removed from St. Joseph, Mo., to Chicago. The change will result in abolishing the offices of Auditor of the Missouri lines, Auditor of Freight Accounts for the Missouri lines and of Assistant Treasurer. (See Chicago, Burlington & Quincy.)

New Brunswick Coal & Railway Co.—W. C. Hunter has been appointed Manager, with headquarters at Norton, N. B.

New York Central & Hudson River.—The following promotions and changes have been made: Samuel Goodman, Industrial Agent; Fred L. Pomeroy, Freight Traffic Manager; Francis La Bau, Assistant Freight Traffic Manager; Herbert D. Carter, General Freight Agent, West Shore Railroad; William S. Kallman, First Assistant General Freight Agent, New York Central and the West Shore; Ira H. Hubbel, Second Assistant General Freight Agent, New York Central and the West Shore, and H. W. Henry, Assistant General Coal Agent. The office of Chief of Tariff Bureau has been abolished, and that bureau will be in charge of Mr. Kallman.

New York, Chicago & St. Louis.—James Webster, hitherto Assistant General Freight Agent, has been appointed General Freight Agent, succeeding G. B. Spriggs, resigned, owing to ill health.

Pennsylvania Company.—A. R. Holliday has been appointed Engineer of Maintenance of Way, with headquarters at Indianapolis, Ind., succeeding Cooper Wood, resigned. C. L. Barnaby has been appointed to succeed Mr. Holliday as Assistant Engineer, with headquarters at Chicago, Ill.

St. Louis & San Francisco.—The following appointments and changes have been made: J. A. Middleton has been appointed Freight Traffic Manager of the 'Frisco and the Chicago & Eastern Illinois, with headquarters at St. Louis. The jurisdiction of Bryan Snyder, Passenger Traffic Manager of the 'Frisco, with headquarters at St. Louis, has been extended to include the C. & E. I. E. K. Voorhees, Assistant General Freight Agent of the 'Frisco at Memphis, becomes General Freight Agent at St. Louis. H. G. Wilson, Assistant General Freight Agent of the 'Frisco, becomes Foreign Freight Agent of both the 'Frisco and the C. & E. I., with headquarters at St. Louis.

St. Louis, San Francisco & Texas.—W. C. Preston has been appointed General Freight Agent and W. A. Tuley, General Passenger Agent, with headquarters at Sherman, Texas.

Wheeling & Lake Erie.—Dwight Carson has been appointed Superintendent of Dining Car and Parlor Car Service, with headquarters at Detroit, Mich.

Southern.—R. L. Ettenger, hitherto Mechanical Engineer of the Cleveland, Cincinnati, Chicago & St. Louis, has been appointed Consulting Mechanical Engineer of the Southern, succeeding F. N. Hibbits, resigned. E. H. Kemper has been appointed Auditor. C. B. Hayes has been appointed Assistant Auditor, succeeding Mr. Kemper, and Mr. Hayes in turn is succeeded by E. T. Jones as Auditor of Revenue. W. L. Bird becomes Auditor of Freight Accounts, succeeding Mr. Jones.

A. H. Plant has been appointed Comptroller, with office in Washington.

LOCOMOTIVE BUILDING.

The United Fruit Company is having one locomotive built at the Baldwin Locomotive works.

The Old Dominion Coal & Mining Company is having one locomotive built at the H. K. Porter works.

The Central Railroad of Brazil is reported to be asking bids on four locomotives. All proposals must be received by July 9.

The Chihuahua & Pacific, as reported in our issue of June 10, has ordered two locomotives from the American Locomotive Co. These locomotives are being built at the Brooks works.

CAR BUILDING.

The Atlantic Coast Line is preparing specifications on 1,000 box cars.

The American Car & Foundry Co. has miscellaneous orders for 40 cars.

The San Pedro, Los Angeles & Salt Lake is reported in the market for new equipment.

The Itasca Lumber Company is having 20 freight cars built by the Russell Wheel & Foundry Co.

The Ann Arbor has ordered two combination passenger and mail cars from the American Car & Foundry Co.

The Great Northern has ordered 10 combination baggage and mail cars and 6 postal cars from the American Car & Foundry Co.

The Minneapolis & St. Louis has ordered 500 wooden box cars of 60,000 lbs. capacity from the American Car & Foundry Co. for September delivery. The cars will weigh about 31,000 lbs., and measure 34 ft. long, 8 ft. 3 in. wide and 7 ft. 1 in. high, inside measurements. The special equipment includes steel axles, Simplex bolsters and brake-beams, Streeter steel back brake-shoes, National-Fulton brasses, Climax or Tower couplers, Climax and Williams doors, Miner draft rigging, Minneapolis & St. Louis standard paint, Hutchins sectional inside metal roofs, Railway Steel-Spring Co.'s springs, metal arch bar trucks and American Car & Foundry Co.'s cast-iron wheels.

BRIDGE BUILDING.

AFTON, N. Y.—A vote will be taken on the question of building an iron bridge over the Susquehanna river, to cost about $25,000, to replace the old suspension bridge.

BRADLEY, ONT.—Thomas Fullerton is receiving bids for a steel bridge with span of 80 ft. and two concrete abutments.

BRIDGEPORT, CONN.—This city will pay about $14,000, Fairfield $3,000 and the Connecticut Railway & Lighting Co. $3,000 toward building a bridge over Ash Creek.

BROOKLYN, N. Y.—Plans for the elimination of grade crossings on the Brighton Beach road at Park place and Prospect place have been submitted to the City Commissioner of Works for his approval, and bids will soon be asked. The improvements include an elevated structure about 1,000 ft. long, to cost $102,000.

CAIRO, ONT.—A new steel bridge on concrete and masonry abutments will be built at Mosside, Euphemia township. Address Angus Smith, C.E., Stratford, Ont.

CHESTER, PA.—The Jury appointed by the Delaware County Court will recommend the building of the bridge over Darby Creek, which is the dividing line between Delaware and Philadelphia Counties. Plans are being made which provide for a roadway of 36 ft. with 8 ft. sidewalks, at a cost of about $25,000.

CLEVELAND, OHIO.—Bids are wanted July 27 by the Board of Commissioners of Cuyahoga County for building a steel bridge in Newburgh Township, also for a concrete-steel bridge in East Cleveland Township. Julius C. Dorn is Clerk.

COLUMBUS, OHIO.—Bids are wanted July 19 by the County Commissioners for some new bridges and repairs to others in Franklin County. John Scott is Clerk of the Board.

GALVESTON, TEXAS.—Heavy rains in Bee County have destroyed nearly all the bridges, including a large number of railroad structures.

INDIANAPOLIS, IND.—Bids are wanted July 26 by the Board of Commissioners of Marion

County for building a bridge over Fall Creek. Cyrus J. Clark is County Auditor.

JONESVILLE, LA.—A bridge 375 ft. long is proposed over the Little River between this place and Trinity. Address I. E. Mullins.

LISTOWEL, ONT.—W. E. Binning, architect, is receiving bids for building a steel truss highway bridge across a branch of the Maitland River, four miles west of Atwood, Ont. It is to be 75 ft. long, with 16 ft. roadway.

MELITA, MAN.—The Town Council has decided to build a steel bridge over the Souris River.

NEWARK, N. J.—Bids are wanted July 11 by the Board of Chosen Freeholders for six bridges of masonry and steel beams and arches, and for two bridges of masonry abutments, plate girders and brick arches; also for a bridge of two spans, each 100 ft. long and 40 ft. wide, with abutments and piers at Parkway, Glen Ridge; for the superstructure steel beams and brick arches of a bridge 26 ft. long and 20 ft. wide at Swamp Road, Caldwell, and for an arch 12 ft. long and 50 ft. wide at John street, Nutley. Separate bids are wanted for the masonry and the steel work, or for concrete instead of masonry. James Owen is County Engineer.

NEW HAVEN, CONN.—The contract for the superstructure of the Kimberly avenue bridge will soon be awarded. The lowest of the former bids submitted was that of the King Bridge Co. for $71,485. The other bids ranged up to that of the Berlin Construction Co., at $76,417. The contract for the substructure was awarded on June 10 to C. W. Blakeslee & Sons at $83,725.

PASSAIC, N. J.—The contract for the new county bridge at the foot of Gregory and Main avenues, Passaic, will probably be awarded to the Frank R. Long Company by the joint committee on county bridges of Bergen and Passaic County Freeholders. This company's bid of $58,700 was the lowest of seven.

PITTSBURG, PA.—The Pittsburg Railways Co. is to build the following bridges: At Ingram over the Pittsburg, Cincinnati, Chicago & St. Louis, a steel bridge 40 ft. long, to cost about $40,000, and at Turtle Creek Borough, over Thompson's run, a steel bridge 50 ft. long, to cost about $8,000, for which bids are wanted August 15 by F. Uhlenhaut, Jr., Chief Engineer; at Verona a viaduct over the railroad, to cost $20,000; bids will be asked by G. S. Davison, 512 Smithfield street, Pittsburg, in September; at Bellevue over Spruce run, a viaduct to cost $35,000; bids will be asked by G. A. Gilfillan, Fidelity Building, in September; at McKees Rocks over Chartiers Creek, a viaduct and a 150-ft. span, to cost $35,000, to be a combined county, street and railroad bridge, for which bids will be asked by C. A. Davis, County Engineer, in September; at West Liberty, three viaducts, for which bids will be asked by A. D. Neeld, Times Building, Pittsburg, in September.

PROVIDENCE, R. I.—The city and the New York, New Haven & Hartford, it is reported, have reached an agreement to eliminate grade crossings at Acorn, Grove and Dyke streets. The plans made by the City Engineer call for the building by the railroad of a steel bridge over the tracks from a point near the junction of Arthur avenue and Dean street to Harris avenue, at a cost of about $150,000 and approaches with retaining walls of about 1,000 ft. to be built by the city.

RED BLUFF, CAL.—Tehama County will take action in September on the question of building a bridge 1,550 ft. long over Sacramento River sloughs, with steel tubing and wooden beams, at a cost of $34,000. W. F. Luning is City Engineer.

ROCHESTER, N. Y.—Bids may soon be asked by W. K. Gillette, Clerk of the Board of Supervisors, for building a cantilever steel bridge about 700 ft. long over the Genesee River in Monroe County.

ROCKPORT, IND.—The County Commissioners, it is reported, will receive bids July 12 for building two concrete arches in Spencer County.

SEAFORTH, ONT.—Bids will be asked by the County Council for building a steel bridge over Sauble River, on the town line between the townships of Hay and Stephen.

SEATTLE, WASH.—Plans have been completed for building two steel bridges on rock foundations over Third and Fourth avenues, on Main and Jackson streets, to cost $55,000. The Main street bridge will be 66 ft. wide and 125 ft. long and the one on Jackson street 85 ft. wide and 115 ft. long.

TEMPLE, TEXAS.—Residents and the railroads interested are considering the question of building a viaduct at several points over the Santa Fe tracks, to cost about $20,000.

TRENTON, PA.—A new company, recently formed, to be called the Yardley Bridge Co., of which Robert A. Montgomery is President, Richard Reading, Treasurer, and Col. John T. Van Cleff, Secretary, with office at 182 East State street, Trenton, has bought the franchise of the Yardley Bridge over the Delaware, four miles north of Trenton. The company proposes to immediately build a highway bridge suitable to carry electric car tracks.

WALKERTON, ONT.—Alex. Anderson, Reeve Township of Brant, is receiving bids for building two cement concrete abutments and steel superstructure for a 140-ft. span steel bridge over the Saugeen River.

Other Structures.

CLEBURNE, TEXAS.—The shops of the Gulf, Colorado & Santa Fe Railroad at Cleburne were destroyed by fire July 2; loss about $300,000, divided as follows: On shops, $75,000; machinery, $150,000; passenger cars, about $60,000.

DENVER, COLO.—The Denver, Northwestern & Pacific will build a stone and brick passenger station 170 ft. long. Work will be begun as soon as the contract is awarded.

E. ST. LOUIS, ILL.—The Southern, it is reported, has plans made and grounds surveyed at Main and Railroad avenues, for the erection of a brick passenger and freight station, to cost about $40,000.

EL RENO, OKLA. T.—The Chicago, Rock Island & Pacific, it is reported, has decided to build a brick and stone passenger station here.

FORT WILLIAM, ONT.—The Canadian Pacific Railway is preparing to build a large grain elevator and to enlarge its freight sheds.

GRAND RAPIDS, MICH.—The Muskegon Interurban, it is reported, is planning to build a freight terminal, to cost, with other improvements, about $25,000. It will include a building of brick or stone, 120 ft. x 220 ft.

HARRISBURG, PA.—The Central Pennsylvania Traction Co. has plans ready for building brick and iron car barns about 460 ft. long. There will also be included in the building a machine shop and blacksmith shop for repairing its cars.

ROANOKE, VA.—The Norfolk & Western, it is reported, has given to John P. Pettyjohn & Co., of Lynchburg, at $100,000, the contract for its new passenger station here. The company, it is also reported, will build a large roundhouse in the west end in addition to the one already there.

STRATFORD, ONT.—The Grand Trunk shops are to be enlarged, at a cost of upward of $100,000.

SOUTH MCALESTER, IND. T.—A new union station is to be built here, to cost about $31,000; work will be commenced about September 1.

WASHINGTON, D. C.—Bids were opened last week for excavating for the foundations for the new office building for the House of Representatives. The lowest bid was that of the Brennan Construction Company, of Washington, $44,760, and the other bids were as follows: New York Continental-Jewell Filtration Company, $129,600; F. Saxton, $93,000; Cogan Brothers & Forschner, $89,950; McMullin & McDermott and Hoffman Engineering Company, $69,700; Daniel Sheehan, $69,459; Cranford Paving Company, $64,600; Ferguson Construction Company, $63,000; S. S. Carmody, $59,850; L. Pavarini, $59,500, and the Douglass Gilmore Company, $56,345.

YANKTON, S. DAK.—The Chicago, Milwaukee & St. Paul station has been destroyed by fire; loss $20,000. The company is considering the question of putting up a new station, to cost $40,000.

RAILROAD CONSTRUCTION.

New Incorporations, Surveys, Etc.

ABERDEEN & ROCK FISH.—Grading has been completed for a distance of five miles on the extension of this road from Rock Fish to Hope Mills, N. C., 7 miles. Track laying is now in progress. John Blue, Aberdeen, N. C., is President.

ALLINGTON SHORT LINE.—This company has been chartered to build a railroad from Allington, Nicholas County, W. Va., to Delphi in the same county. Incorporators: J. C. Roane, J. S. Smith and others, of Weston, W. Va.

ATLANTA, KNOXVILLE & NORTHERN.—Press reports state that trains will be running from Knoxville to Jellico by October 1. The heading of Cove Creek tunnel, south of LaFollette, has been cut through, and work is being pushed on the Dossetts and Black Oak tunnels.

BATESVILLE & JACKSONPORT.—According to press reports work will be begun at once on this railroad, which is projected to run from Batesville, Ark., to Jacksonport, 22 miles. The new road will follow the line of the old Batesville & Brinckley Railroad for the greater part of the distance between the two cities. H. Devereux, Little Rock, Ark., is President.

GREAT NORTHERN.—Press reports state that a contract has been let to J. W. Stewart for grading the extension of this road from Morrissey north to Fernie, 10 miles. The grading on the Kalispell cutoff of this road is nearly finished. The cutoff runs from Columbia Falls west to a junction with the Fernie branch, north of Jennings, 72 miles. The work is said to be the heaviest ever done in the Northwest. The old line by way of Kalispell has a 2 per cent. grade, and the Haskett tunnel, 1,500 ft. long. On the new portion there is only ½ of 1 per cent. grade and an 800-ft. tunnel. (March 8, p. 222.)

ILLINOIS VALLEY.—This company has been incorporated in Illinois, with a capital of $100,000, to build from Joliet southwest to Morris, thence west through Marseilles and Peru to Spring Valley. F. W. Bedard, La Salle, Ill., C. E. Hook, Ottawa, and others are interested.

LEECH LAKE & NORTHERN.—This company has been incorporated in Minnesota to build a railroad to a large tract of pine land. M. H. McCarthy, Dubuque, Iowa; Augustus W. Clapp, St. Paul, and others are the incorporators.

MEXICAN ROADS.—The Palmillas Railroad is arranging for building an extension through Ayapasco, Santa Rosalia, Crestones and San Miguel, in the State of Morelos, Mexico. From San Miguel the line will pass through agricultural country in the southern part of the State and will connect with the Aricola Railroad at El Carmin.

OAKDALE & WESTERN.—Incorporation has been granted this company to build from Oakdale to Riverbank, on the Santa Fe, 6 miles, connecting the Santa Fe with the Sierra Railroad at Oakdale. Contract for grading has been awarded. The headquarters are at Tuolumne City, Cal.

PENNSYLVANIA.—This company has put in operation six miles of second track between Alliance, Ohio, and Atwater. Work is now in progress on an additional six miles between Atwater and Rootstown. When this is

finished, the Pennsylvania will have a double track line from Cleveland to Alliance with the exception of a stretch 12 miles long north of Rootstown. It is stated that work on this section will be begun at once.

Pensacola-Andalusia.—Plans are now being perfected for building a railroad from Pensacola, Fla., to Andalusia, Ala., 80 miles. Connection will be made at the latter point with the Central of Georgia. A. B. Steele, Pensacola, is said to be interested.

Red Lake & Manitoba.—Articles of incorporation have been filed by this company in Minnesota. The new company will build a railroad from Lower Red Lake, Beltrami County, to White Fish Lake, thence south and east to connect with the Minnesota & International in Beltrami County, and thence to Minneapolis. Charles M. Amsden, Charles A. Smith, Charles J. Johnson and others of Minneapolis are incorporators.

St. Clair Coal R. R.—This company has been incorporated in Illinois to build from Collinsville in Madison County southwest to a point in St. Clair County. L. O. Whitney, Vienna, Ill.; W. S. Forman, East St. Louis, and others are incorporators.

St. Louis, Brownsville & Mexico.—On July 3 this company opened its main line, running from Brownsville, Tex., to Sinton, 141 miles. Connection is made with the San Antonio & Aransas Pass Railroad at Sinton. It is the purpose of the company to eventually extend its line from Sinton northeast to Columbia, 150 miles. F. G. Jonah, Corpus Christi, Tex., is Chief Engineer. (June 10, p. 450.)

Toledo & Point Place.—This company has been incorporated by John A. Dunn, William R. Leflet and others, of Toledo.

Union Terminal.—This company has been incorporated in Ohio with an authorized capital of $100,000. The company will build a belt line in and about Cincinnati. O. J. Cosgrove, J. H. Woodward and others of Cincinnati are incorporators.

RAILROAD CORPORATION NEWS.

Arkansas, Missouri & Kansas.—G. N. Lindsay, Treasurer, Chanute, Kan., is receiving subscriptions to the first issue of 50-year 5 per cent. gold bonds of this company. These bonds are to be a first lien on the first section of the road, which is now building from Chanute to Joplin, Mo., 85 miles.

Chicago & Alton.—Kuhn, Loeb & Co. have announced that deposits of preferred stock of this road will not be received after July 15. Under the terms of the original circular, issued last December, the managers of the pool reserved the privilege of terminating the offer to receive stock. The pool terminates by limitation on September 30 and formal announcement of the termination of the syndicate will be made later.

Chicago, Burlington & Quincy.—Sealed proposals will be received until July 15 by the New England Trust Company, of Boston, to sell $101,997 C., B. & Q. Denver Extension 4 per cent. bonds, or any part thereof.

Detroit Southern.—On the petition of John F. Jacobs, a bridge contractor of New York, Judge Swan has entered an order in the United States Circuit Court appointing Samuel Hunt receiver of this railroad. Mr. Jacobs has a claim for the cost of building a bridge over the Scioto River, near Waverly. The company recently defaulted payment on its first mortgage 4 per cent. bonds, the receipts having decreased heavily. (See June 3, p. 430.)

Great Northern of Canada.—The Central Trust Company confirms the report that it has not received any funds for payment for the July coupons on the bonds of the Great Northern Railroad of Canada. This road owns the main line between Riviere-a-Pierre, on the Quebec & Lake St. John Railroad, a distance of 168 miles. Of $6,000,000 first mortgage 5 per cent. bonds, $3,540,000 are outstanding. It is the interest on this latter amount which is in default.

Illinois, Iowa & Minnesota.—A mortgage has been recorded with the Illinois Trust & Savings Bank, of Chicago, as trustee, securing an authorized issue of $5,000,000 5 per cent. bonds. These bonds will be a first lien upon the road, which is now being built north and south between Momence, Ill., and Rockford, 120 miles. The section between Aurora and DeKalb, 27 miles, is practically finished. The company recently increased its authorized stock to $5,000,000. H. W. Seaman, Chicago, Ill., is President.

Midland Valley.—A mortgage for $1,100,000 has been filed by this company with the Girard Trust Co. of Philadelphia, covering 55 miles between Hartford and Muskogee, Ind. T., and a contemplated extension toward Archeta, Kan.

Minneapolis, St. Paul & Sault Ste. Marie.—The stockholders of this company will meet September 20 to vote on the proposition approved by the directors of buying the Bismarck, Washburn & Great Falls. The latter road runs from Bismarck, N. Dak., to Underwood, 58 miles. When the purchase is accomplished the present mortgage on this road will be canceled, as all the bonds are now owned by the M., St. P. & S. S. M.

New York, Ontario & Western.—At a meeting of the directors on June 29 the report of the special committee, consisting of G. B. Schley, C. L. Blair and G. L. Hoyt, was approved. This committee, which was recently appointed to investigate the question of paying dividends, has reported adversely to a dividend declaration and to the terminating of the voting trust. This trust, it is asserted, must continue, because 10 of the 20,000 shares of preferred stock remain outstanding, and according to the Act of 1885 the trust can only be dissolved upon the retirement of all the issue.

Pennsylvania.—The report of the lines directly operated east of Pittsburg for the month of May shows a decrease in gross earnings of $518,400, and a decrease in net of $389,600. The lines west of Pittsburg show a loss of $539,100 in gross, and $228,900 in net. For the five months ending May 31 the gross earnings of the entire system decreased $3,448,200, while the net earnings decreased $4,750,400.

Quebec Southern.—The Exchequer Court at Montreal has announced that bids will be received until August 3 by the Register of the Court at Ottawa for the purchase of the Quebec Southern and the South Shore Railroads. These two roads run from Sorel, Quebec, to Noyan Junction, 88 miles, and from Montreal to Sorel, 51 miles. (April 1, p. 264.)

Third Avenue (New York).—Official announcement has been made that on July 30 the first dividend rental to the stockholders of this company will be paid by the New York City Railway Company. The dividend will be 1¼ per cent. for the quarter. This is in accordance with the agreement of 1899, stating that after four years the stockholders should receive 5 per cent. dividends.

Ulster & Delaware.—Redmond & Co., of New York, are offering at 91 and interest, $500,000 first refunding mortgage 4 per cent. 50-year gold bonds of this company. The announcement says that these bonds are secured by a mortgage covering the entire property of the Ulster & Delaware, consisting of 129 miles of railroad. On the twenty miles of main line from Bloomville to Oneonta, and on eight additional miles, these bonds are a first mortgage, and on the remaining 101 miles they are subject to only $2,000,000 first mortgage 5s, to retire which at maturity sufficient refunding 4s are reserved. The total bonded debt per mile is about $21,000, including all terminals and equipment.

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EDITORIAL ANNOUNCEMENTS:

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CONTRIBUTIONS.—Subscribers and others will materially assist in making our news accurate and complete if they will send early information of events which take place under their observation. Discussions of subjects pertaining to all departments of railroad business by men practically acquainted with them are especially desired.

ADVERTISEMENTS.—We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay, EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and these only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers, can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially either for money or in consideration of advertising patronage.*

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